UNDERSTANDING CANCER
IN NOVA SCOTIA

A statistical report by ***Cancer Care Nova Scotia*** with a focus on 2000-2004

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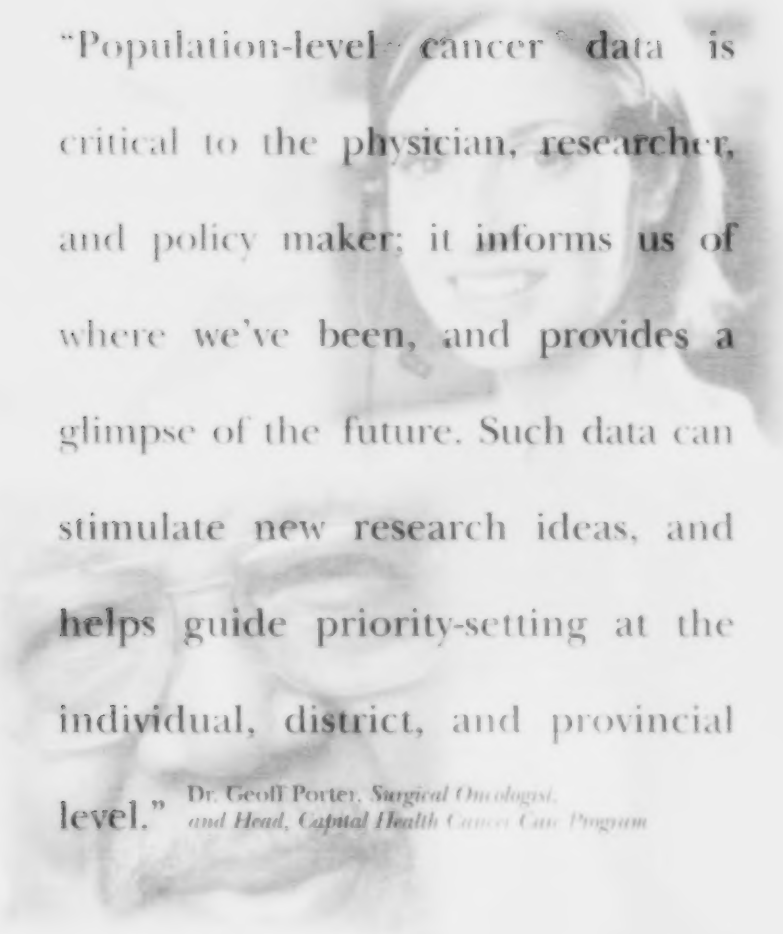

"Population-level cancer data is critical to the physician, researcher, and policy maker; it informs us of where we've been, and provides a glimpse of the future. Such data can stimulate new research ideas, and helps guide priority-setting at the individual, district, and provincial level."

Dr. Geoff Porter, *Surgical Oncologist, and Head, Capital Health Cancer Care Program*

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A statistical report by *Cancer Care Nova Scotia* with a focus on 2008-2011

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FOREWORD

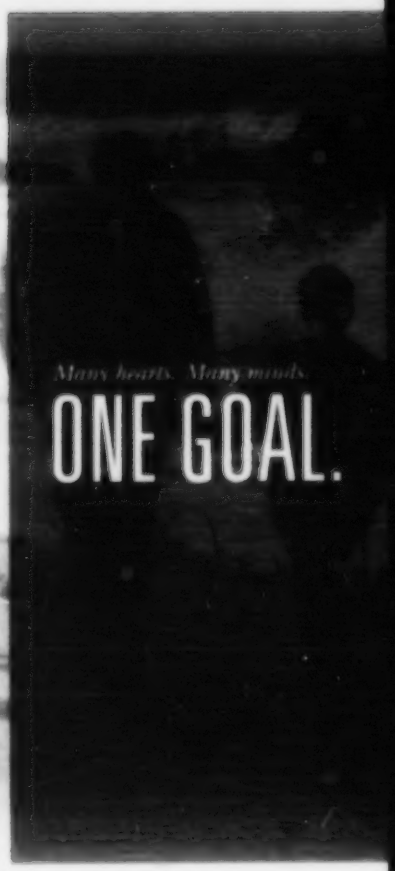
Understanding cancer is critical to effective cancer control. Such knowledge informs Nova Scotians about the burden of the disease and guides interventions directed at prevention and the care of cancer patients. It is a key component in evaluating programs, and determining if the best possible outcomes are being achieved for those with the disease.

Since 1964, data has been collected on all diagnosed cancers. With the advent of *Cancer Care Nova Scotia* and the organization of its Surveillance and Epidemiology Unit, we are able to collect, analyze and report on the data in order to understand the disease and its impact, now and into the future. With this understanding, we are in the position of developing policies and programs from prevention to palliation, that affect clinical practice, system development and most, importantly, patient outcomes.

Through the analysis reported in this publication, we can examine how best practices in cancer prevention, care and treatment are being applied in Nova Scotia. We are seeing improvement in areas such as breast and lung cancer for selected patient groups. We can also better predict the need for oncology services across the province. Finally, with the help of the data and analysis, we can identify where we need to focus our efforts in research to address those things which we don't yet know, or understand. This monograph, therefore, is a driver for policy development, clinical and health services research and program evaluation.

With the analysis contained in this publication, we are improving our understanding of how cancer affects this province and are better prepared to address current and future needs.

Theresa Marie Underhill
Chief Operating Officer
Cancer Care Nova Scotia



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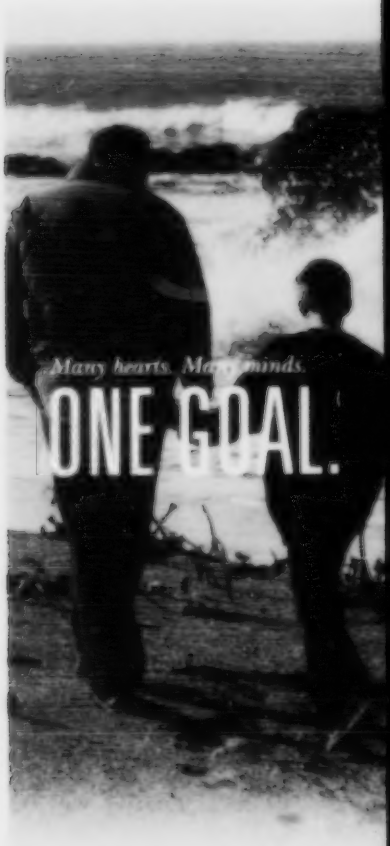

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INTRODUCTION

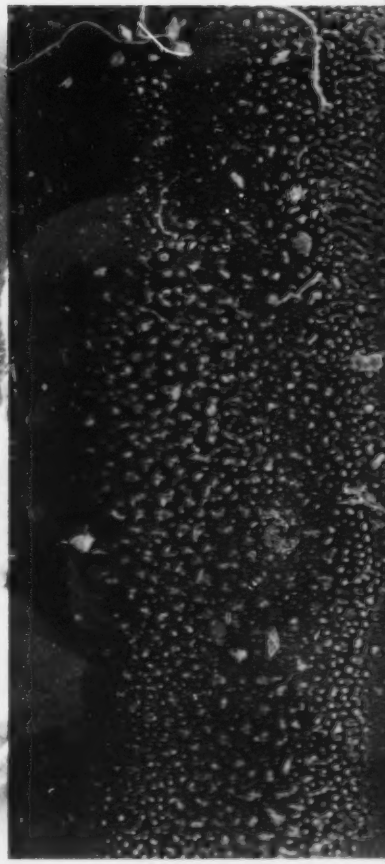
Cancer embraces a multitude of diseases with different etiologies, presentations and degrees of severity. It poses an ever increasing threat to populations and health care systems on all fronts, local, national and international. It has no boundaries, affecting people across genders, ages, ethnicities and geography. Cancer is now a chronic disease that affects approximately 153,100 Canadians annually[1] and more than 11 million people worldwide *(www.who.int/cancer/en)*.

In Nova Scotia, nearly 8,400 residents experienced a cancer diagnosis in 2004. Today, nearly 28,000 Nova Scotians (1 in 34) are living with an invasive cancer, diagnosed within the previous 15 years. Cancer incidence increases with age and in Nova Scotia, two-thirds of new cases occur in those over 60 years of age. As the baby boomers age, the incidence of cancer is expected to increase substantially and so too the demands for treatment and care.[2] The health care system currently struggles to address the pressure resulting from the growing cancer burden and the spiralling costs and complexity of care. Enhanced disease surveillance and prospective monitoring of system performance will be essential for the provision of sustainable, effective, and timely cancer services.

In parallel to informed cancer planning and system management, a critical need for reducing the future burden of cancer has emerged. Nearly 50% of all cancers are deemed preventable through the adoption of healthy eating habits, active and tobacco-free lifestyles and by avoiding exposure to ultraviolet rays and known environmental carcinogens and infectious agents.[3,4,5,6] Screening and early detection programs to identify and treat precancerous conditions and early stage disease will be crucial to complement risk factor reduction through primary prevention.

To date, the main approach in the battle against cancer has been reactive, focusing on diagnosis and treatment. Approximately 80% of national research funding is allocated to basic research, diagnosis and treatment; supportive and palliative care and cancer prevention share the remaining funds.[7] This reactive tactic, alone, is not sustainable. Clearly, we must prepare to address the emerging cancer demand and concurrently take advantage of any and all opportunities to reduce the future burden. It will take time to reap the benefits, but increased efforts at prevention and early detection must be emphasized now. Cancer control involves a continuum from prevention and screening, diagnosis through treatment, supportive care and palliative care.[2] A proactive and comprehensive approach focusing upon all components of the continuum, as well as the transitions that bridge these components, is key to our future.

This publication is a step toward understanding cancer in Nova Scotia. It profiles cancer incidence and addresses issues relating to cancer survival, prevalence and projections while emphasizing the overarching need for a coordinated and comprehensive cancer control program.



Estimate includes invasive (5,147 cases, in situ (847 cases – see Appendix A) and basal cell and squamous cell skin cancers (2,366 cases) diagnosed in 2004

HIGHLIGHTS

■ In 2004, twenty-three Nova Scotians were diagnosed daily with some form of cancer (i.e. in situ, invasive or non-melanoma skin cancers).

■ In 2004, just over 27,700 people were living with an invasive cancer diagnosis.

■ Age-standardized cancer incidence *rates* have increased slightly but not significantly since the early 1990s, and cancer mortality *rates* have either remained stable (females) or decreased (males). However, the *number* of people diagnosed with and dying from cancer continues to rise steadily with the rapidly aging population. As the number of newly diagnosed patients and cancer survivors continues to rise, so too will the demand for diagnostic, treatment, follow-up and supportive care services.

■ Prostate, lung and colorectal cancers accounted for 59% of all cancers diagnosed in males between 2000 and 2004. A similar proportion (57%) was accounted for by breast, colorectal and lung cancers in females.

■ Lung cancer was the leading cause of deaths, accounting for 31% and 24% of cancer deaths in men and women, respectively.

■ In 2004, Nova Scotia women continued to be diagnosed with lung cancer at a rate nearly six times greater than they were in 1971. However, although these rates continue to increase among women aged 55 years and younger, they have stabilized among women aged 70+ and appear to be dropping among women aged 55-69.

■ The rate of breast cancer, the most commonly diagnosed cancer among women has declined 13.5% since 1998. This decline is associated with a notable reduction in the incidence rate of invasive breast cancer among women aged 55-69 and a continued increase in the proportion of in situ breast cancers. Sustained mammography screening efforts that detect tumours at an early stage may be driving these patterns.

■ Male mortality due to cancer has decreased significantly since 1992, largely due to a 21% decline in mortality associated with lung cancer.

■ Female mortality due to cancer has remained stable since 1971. However, female cancer mortality due to all cancers, other than lung cancer, has dropped 22.7% over the past 34 years.

■ Five-year relative survival ratios were highest for patients diagnosed with prostate cancer (98.3%), followed by breast (86.3%), colorectal (males: 56.3%; females: 58.5%), and lung cancer (males: 14.6%; females: 16.9%). Irrespective of the cancer type, survival ratios were consistently higher for patients diagnosed at an early disease stage.

■ Five-year survival ratio of females diagnosed with invasive breast cancer between 1997 and 2001 was higher than that of women diagnosed between 1992-1996 (86.3% [95% CI: 84.1-88.1] vs 82.1% [95% CI: 79.9-84.2]). This small but significant improvement may reflect increased screening efforts and better adherence to evidence-based treatment guidelines which ensures that Nova Scotian women access and benefit from the most current standard of care.

■ Cancer control involves a continuum of potential interventions that includes disease prevention, screening, diagnosis, treatment, supportive care and palliative care. A proactive and comprehensive approach focusing on all components of the continuum, as well as the transitions that bridge these components is necessary if cancer care is to be sustainable and viable.

■ Nearly 50% of all cancers are deemed preventable through the adoption of healthy eating habits, active and tobacco-free lifestyles, and by avoiding exposure to ultraviolet rays, and known environmental carcinogens and infectious agents.

■ Healthy lifestyle must become the norm in Nova Scotia. Currently, 22.6% of Nova Scotians smoke, 66.7% do not meet the daily recommended intake of fruit & vegetables, 50.8% are physically inactive and 58% are overweight or obese, yet 85.8% of the population consider themselves healthy.

HIGHLIGHTS

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"Good data is essential to all of us who are charged with the responsibility of delivering cancer care. Good data equals better care, which results in better health in our communities and province." John Malcom, *CEO, Cape Breton District Health Authority*

CANCER REGISTRY BACKGROUND

The ability to profile and understand the occurrence and patterns associated with the many diseases collectively referred to as 'cancer' is a critical aspect of operating a comprehensive cancer control program. In Nova Scotia, responsibility for cancer control falls under the auspices of *Cancer Care Nova Scotia*, a program of the provincial Department of Health. This program oversees the operation of a population-based cancer registry that collects key data related to individuals diagnosed with cancer. Nova Scotia has operated a cancer registry since 1964, which today, over forty years later, provides a rich resource for research, including the production of descriptive information on the cancer situation in this province. This report has utilized the registry to examine the occurrence and patterns of cancers for a variety of time periods, starting in 1971 and ending in 2004. A detailed methodology and reference to data sources and quality can be found in Appendix B.

CANCER INCIDENCE AND MORTALITY

Cancer Types and Sex

More than 25,000 people in Nova Scotia were diagnosed with invasive cancer between 2000 and 2004. There were 9% more cancers diagnosed in males (13,265 people) than in females (11,809 people; see Tables 1-2). On average, approximately 5,000 invasive cases were registered annually.

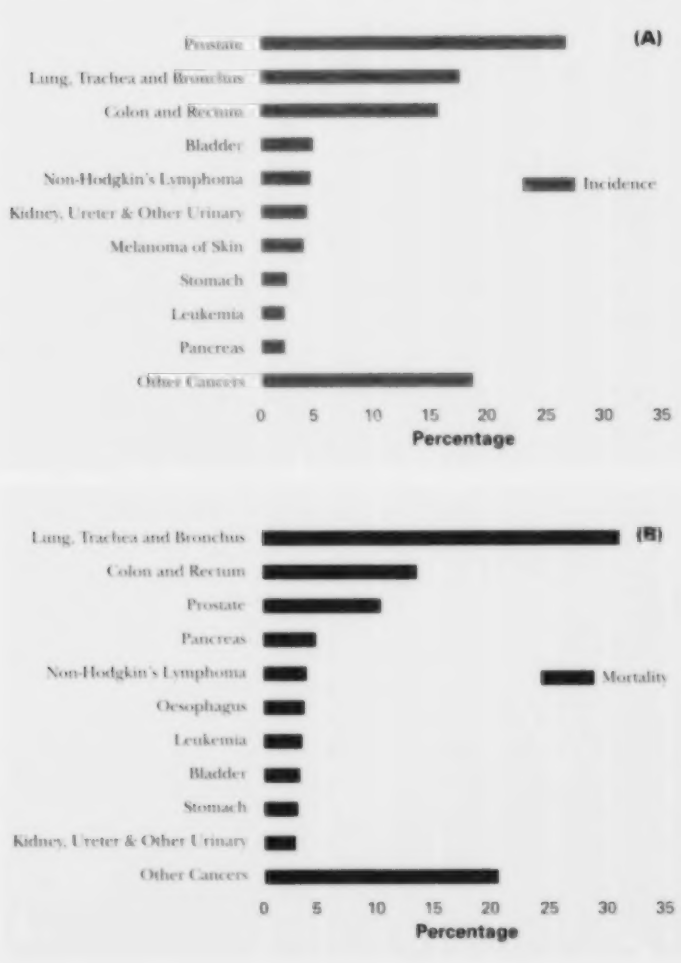
Prostate, lung and colorectal cancers accounted for 59% of all cancer cases recorded for males between 2000 and 2004 (Figure 1A). A similar proportion (57%) was accounted for by breast, colorectal and lung cancers for females (Figure 2A). More than half of all cancer deaths recorded in the province are related to these four cancers (Figures 1B-2B). Among males, prostate cancer was the most frequently diagnosed cancer type, affecting nearly 700 men in the province annually (Table 1). Females were most often diagnosed with breast cancer (Table 2). In Nova Scotia,

Table 1 Incidence counts[1] and rates of invasive cancer among males, Nova Scotia 2000-2004.[2]

MALES	Age at Diagnosis						Total New Cases		Incidence Rate[3] per 100,000	
Cancer Type	**0-29**	**30-49**	**50-59**	**60-69**	**70-79**	**80+**	**2000-04**	**2004**	**2000-04**	**2004**
Prostate		77	546	1,240	1,120	471	3,454	733	136.2	137.4
Lung, Trachea and Bronchus		81	319	695	838	362	2,295	470	90.5	88.7
Colon and Rectum (Colorectal)	7	136	336	506	627	435	2,047	409	80.2	76.7
Bladder		30	70	152	195	144	591	101	23.4	19.3
Non-Hodgkin's Lymphoma	19	91	127	131	114	55	537	119	20.7	22.3
Kidney, Ureter and Other Urinary	5	57	127	145	120	59	513	105	19.6	19.2
Melanoma of Skin	13	99	95	124	92	63	486	105	19.0	19.5
Oral (buccal cavity and pharynx)		71	101	123	84	41	426	86	16.1	15.9
Stomach		19	42	88	94	62	307	65	12.1	12.1
Leukemia	34	45	39	44	72	62	296	68	12.0	13.5
Pancreas		14	37	81	100	54	286	61	11.3	11.5
Brain	21	40	37	54	31	18	201	39	8.0	7.2
Oesophagus		14	29	64	58	34	199	40	7.8	7.6
Larynx		6	36	51	54	17	164	36	6.3	6.6
Testis	49	69	7				129	33	6.2	8.3
ALL CANCERS	**218**	**1,009**	**2,139**	**3,790**	**3,945**	**2,164**	**13,265**	**2,742**	**522.7**	**518.8**

[1] Age-specific/site-specific counts <5 are not presented to ensure confidentiality.
[2] Incidence counts and rates for less common cancer types are available at www.cancercare.ns.ca.
[3] Rates are age-standardized to the 1991 Canadian population.

Figure 1. Percent distribution of new cases (A) and deaths (B), invasive cancer, males, Nova Scotia 2000-2004. Death counts appear in Appendix C (Table C1).



3,264 women were diagnosed with invasive breast cancer between 2000 and 2004. Over this same period, 890 women died of the disease. Age-standardized cancer incidence rates in Nova Scotia tend to be higher than those reported for Canada as a whole, with lung, colorectal, kidney, melanoma and cervical cancers driving this difference.[1]

Lung cancer remained the leading cause of death for both males and females, accounting for one third of the cancer deaths in men and almost one-quarter of cancer deaths in women (Figures 1B, 2B). Breast cancer ranked second, and prostate cancer ranked third on the scale of cancer-related deaths. Lung cancer age-standardized incidence rates (ASIR) in Nova Scotia are among the highest in Canada.[1] The disease affects a larger proportion of males than

Table 2. Incidence counts[1] and rates of invasive cancer among females, Nova Scotia 2000-2004.[2]

FEMALES	Age at Diagnosis						Total New Cases		Incidence Rate[3] per 100,000	
Cancer Type	**0-29**	**30-49**	**50-59**	**60-69**	**70-79**	**80+**	**2000-04**	**2004**	**2000-04**	**2004**
Breast	9	615	800	656	680	504	3,264	647	105.0	101.4
Colon and Rectum (Colorectal)		113	227	348	524	581	1,797	363	53.6	52.9
Lung, Trachea and Bronchus		96	270	458	545	276	1,649	333	53.2	52.1
Body of Uterus		59	155	154	115	85	568	120	18.4	18.8
Melanoma of Skin	20	143	97	77	78	57	472	99	16.4	16.5
Non-Hodgkin's Lymphoma	7	63	83	87	98	65	403	86	13.2	13.4
Kidney, Ureter and Other Urinary	7	48	54	76	96	77	358	69	11.5	10.9
Ovary	8	48	78	71	80	53	338	56	11.1	8.4
Cervix	24	159	53	26	30	18	310	62	12.2	11.2
Pancreas		14	30	49	84	100	279	72	8.1	10.4
Leukemia	29	37	25	35	58	62	246	47	8.3	7.8
Thyroid	24	102	43	24	15	12	220	51	8.8	9.7
Oral (buccal cavity and pharynx)		15	27	53	42	34	191	43	6.1	6.7
Bladder		8	21	39	64	51	183	36	5.6	5.2
Stomach		14	17	30	54	55	170	38	5.0	5.5
Brain	21	24	24	23	32	25	149	36	5.3	5.9
ALL CANCERS	**224**	**1,681**	**2,163**	**2,455**	**2,894**	**2,392**	**11,809**	**2,405**	**380.1**	**374.3**

[1] Age-specific / site-specific counts <5 are not presented to ensure confidentiality.
[2] Incidence counts and rates for less common cancer types are available at www.cancercare.ns.ca
[3] Rates are age-standardized to the 1991 Canadian population.

females, with ASIR in males being 41% higher (90.5 cases per 100,000; 95% CI: 86.8-94.3; Table 1) than those of females (53.2 cases per 100,000; 95% CI: 50.6-55.8; Table 2). This gap in lung cancer incidence rates between sexes has narrowed in recent years as the rates in males gradually decreased while those in females continued to increase. An increased risk of developing lung cancer has been linked to both tobacco consumption and exposure to environmental tobacco smoke.[7,8,9] In fact, 80-90% of all cases of lung cancer are attributable to tobacco consumption, with an average lag time of about 20 years.[8,10,11,12,13] Currently, the prevalence of regular smoking remains high among adult Nova Scotians (23%), pregnant women (22%) and youth (20%, ages 15-19 inclusive).[14]

Figure 2. Percent distribution of new cases (A) and deaths (B), invasive cancer, females, Nova Scotia 2000-2004. Death counts appear in Appendix C (Table C1).

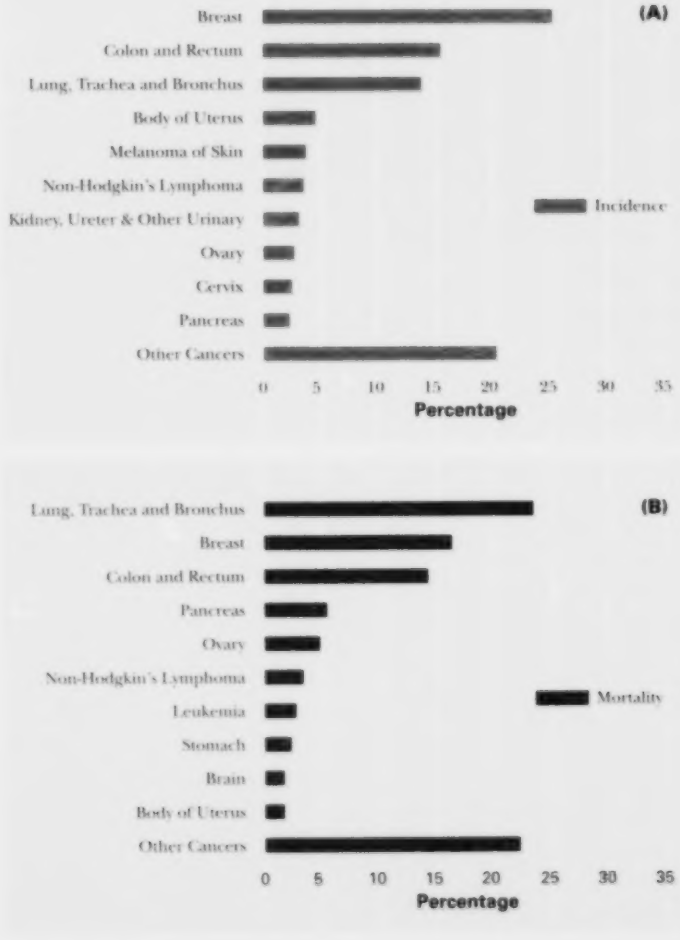


Figure 3. Average annual age-specific incidence rate, all cancers combined, Nova Scotia 2000-2004.

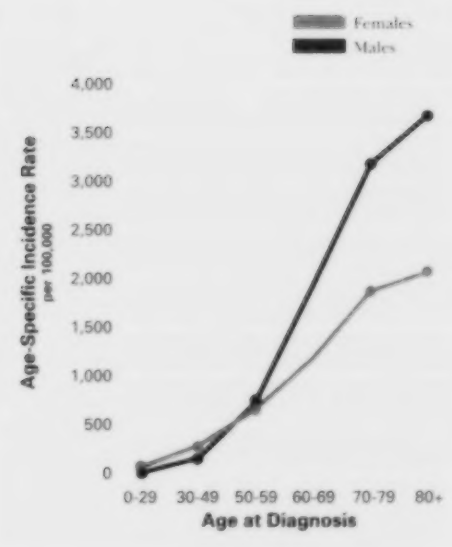


Figure 4. Average annual age-specific incidence rate, common cancers, males, Nova Scotia 2000-2004.

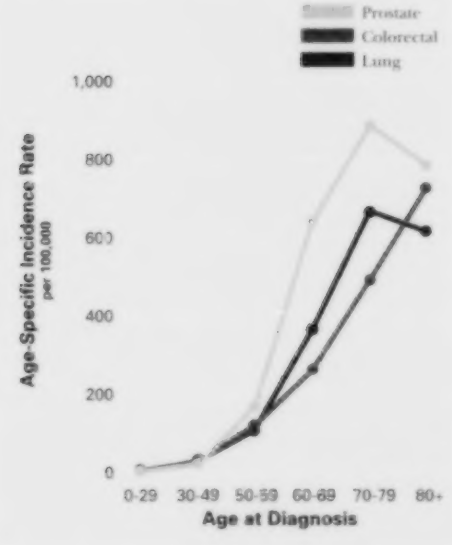
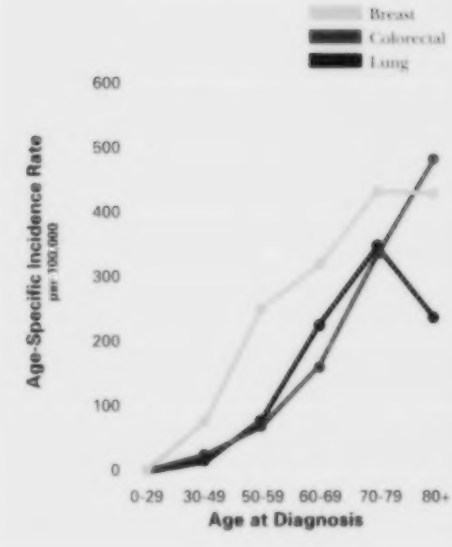


Figure 5. Average annual age-specific incidence rate, common cancers, females, Nova Scotia 2000-2004.



Age and Sex

The incidence of invasive cancer varies greatly with age, sex and the type of tumour. More than two-thirds of all new cancer cases in Nova Scotians occur after the age of 60 years (Tables 1-2). Generally, the relative increase in incidence rates with age is more pronounced for males than for females (Figure 3). For example, males aged 70 to 79 have roughly 60 times the risk of contracting lung cancer relative to men aged 30 to 49, whereas the corresponding relative risk in females is only 26. When all cancer types are combined, male and female incidence rates appear comparable for those aged 59 years or less (Figures 3). However, incidence rates in those aged 35 to 49 are 65% higher in females, a pattern attributable to breast cancer (Figure 3 and see Cancer Care Ontario 2006[5]). After the age of 59, incidence rates rise more rapidly among men, and by age 80+ the incidence rates for males are nearly double those of females. These elevated incidence rates for older males are partly explained by the fact that the leading cancer among men (prostate cancer) generally occurs at a much later age than the leading cancer among women (breast cancer; see Figures 4-5).

Table 3. Incidence counts and rates of invasive cancer among children aged 0-19, Nova Scotia 2000-2004.

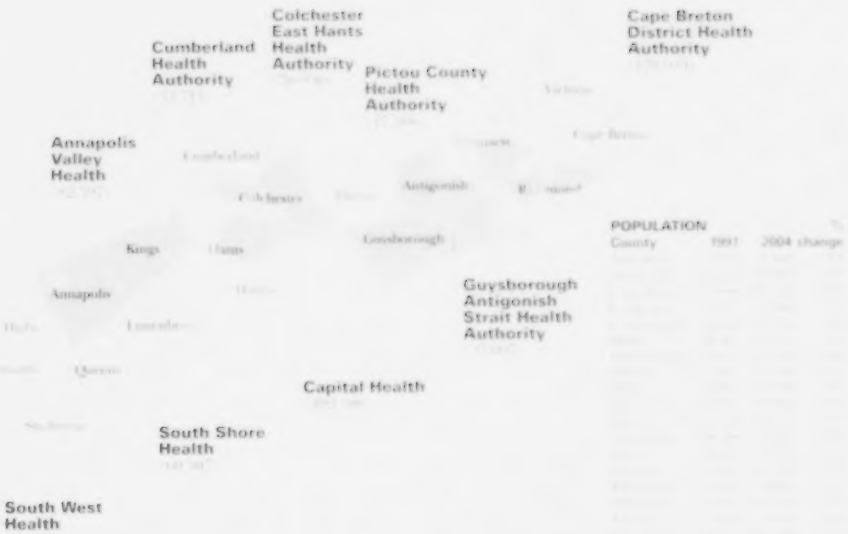
CHILDREN Cancer Type	Total New Cases	Incidence Rate[2] per 1,000,000	95% Confidence Interval
LEUKEMIA	49	46.0	[33.0 - 59.0]
Lymphoid	34	32.4	[21.5 - 43.4]
Acute Non-Lymphocytic	6	6.2	[1.2 - 11.2]
Chronic Myeloid	< 5	2.6	[-0.4 - 5.7]
Other	6	4.7	[0.9 - 8.5]
MYELODYSPLASTIC SYNDROME	< 5	1.9	[-0.8 - 4.5]
LYMPHOMAS	37	29.8	[20.2 - 39.4]
Hodgkin's Lymphoma	26	20.8	[12.8 - 28.8]
Non-Hodgkin's Lymphoma	10	8.2	[3.1 - 13.2]
Other	< 5	0.8	[-0.8 - 2.4]
BRAIN AND SPINAL[3]	38	35.6	[24.2 - 47.1]
Ependymoma	< 5	1.1	[-1.0 - 3.2]
Astrocytoma	22	20.5	[11.8 - 29.1]
Primitive Neuroectodermal	7	6.8	[1.7 - 11.9]
Other	8	7.3	[2.2 - 12.4]
SYMPATHETIC NERVOUS SYSTEM	8	8.2	[2.5 - 13.9]
Neuroblastoma	8	8.2	[2.5 - 13.9]
RETINOBLASTOMA	< 5	3.2	[-0.4 - 6.9]
RENAL TUMOURS	7	7.5	[2.0 - 13.1]
HEPATIC TUMOURS	< 5	4.2	[0.1 - 8.2]
BONE	9	7.6	[2.6 - 12.5]
SOFT TISSUE	12	10.4	[4.5 - 16.3]
GERM CELL AND OTHER GONADAL	7	6.2	[1.6 - 10.9]
CARCINOMAS AND EPITHELIAL NEOPLASMS	15	12.3	[6.1 - 18.5]
ALL CANCERS	**191**	**172.8**	**[148.1 - 197.6]**
Females	**96**	**175.5**	**[140.1 - 211.0]**
Males	**95**	**170.3**	**[135.7 - 205.0]**

[1] Site-specific counts < 5 are not presented to ensure confidentiality.
[2] Rates are standardized to the age distribution of the 1991 Canadian population
[3] Benign and uncertain neoplasms are excluded.

Childhood Cancer

Cancer in children (aged 0-19) is uncommon, representing less than one percent (0.8%) of all cancer cases diagnosed in the province between 2000 and 2004 (Table 3). During this five-year period, a total of 191 children were diagnosed with invasive cancer, an average of 38.2 cases per year. Leukemia accounted for 25.7% of these cases and remained, as reported nationally, the most common of the childhood cancers.[1] Lymphomas (19.5%) and cancers of the brain and spinal cord (19.9%) were also common (Table 3). Differences in the incidence of childhood cancer by age are not detailed in this report to maintain data confidentiality and avoid problems associated with computations based on small numbers.

Figure 6.


Colchester East Hants Health Authority
Cumberland Health Authority
Pictou County Health Authority
Cape Breton District Health Authority
Annapolis Valley Health
Antigonish
Guysborough
Kings
Annapolis
Guysborough Antigonish Strait Health Authority
Capital Health
South Shore Health
South West Health
POPULATION
County 1991 2004 change

GEOGRAPHIC PATTERNS

Regional variations in the incidence of cancer (counts and rates) were examined on two geographical scales: (1) by county and (2) by district health authority (DHA; see Figure 6). Since Nova Scotia is a relatively small province with approximately 937,250 people sharing similar genetic, social, cultural, occupational and environmental traits, one would expect little variation in the patterns of cancer incidence throughout the province. Nevertheless, regional disparities do exist in Nova Scotia, notably for prostate and lung cancers. All rates reported have been standardized to adjust for differences in age distribution between regions of interest, thus facilitating inter-regional comparisons.

Figure 6. Nova Scotia population counts by county and district health authority, 2004.

POPULATION County	1991	2004	% change
Annapolis	24,004	21,860	-8.9
Antigonish	19,530	19,889	1.9
Cape Breton	121,880	109,542	-10.1
Colchester	48,470	51,466	6.2
Cumberland	34,820	32,711	-6.1
Digby	21,565	19,781	-8.3
Guysborough	11,871	9,511	-19.9
Halifax	337,085	379,770	12.7
Hants	38,496	41,796	8.6
Inverness	21,937	19,866	-9.0
Kings	57,338	60,737	5.9
Lunenburg	48,360	48,768	0.8
Pictou	50,417	47,366	-6.1
Queens	13,110	11,739	-10.5
Richmond	11,400	9,995	-12.4
Shelburne	17,605	16,349	-7.1
Victoria	8,928	8,118	-9.0
Yarmouth	28,343	27,586	-2.7
Nova Scotia	915,070	937,250	2.4

Incidence by Counties

all cancer sites - Approximately 50% of all cancers (annual average of 2,474 new cases) were diagnosed in Halifax and Cape Breton counties, where half of the provincial population lives (Tables 4-5; Figure 6). Among males, Pictou and Queens Counties exhibited higher rates relative to the provincial average (39 and 77 more cases per 100,000, respectively); while Colchester County had significantly lower rates (60 fewer cases per 100,000; Figure 7). Rates in Queens County have been increasing gradually over time while those of Pictou appear to have increased only recently (CCAN, unpublished data). Colchester has a long history of low cancer rates among males. Among females, cancer rates were comparable across counties with the exception of Lunenburg, and Kings counties which showed significantly lower rates relative to the provincial average (34 and 29 fewer cases per 100,000, respectively), a pattern which has been consistent over time.

males - common cancer sites - Higher cancer rates among males in Pictou and Queens counties appear driven by prostate cancer where the rates exceeded the provincial average by 24% (33 more cases per 100,000; Figures 7-8). In contrast, the lower rates of cancer observed among males of Colchester County appear to reflect the significantly lower incidence of colorectal cancer (28% lower than Nova Scotia or 22 fewer cases per 100,000; Figure 10). Lung cancer rates among males also tend to be lower in Colchester, although not significantly different from the provincial average (6 fewer cases per 100,000; Figure 9). Cancer rates among males of Cape Breton County have been historically high. For the first time, since at least 1985, rates in Cape Breton have been shown to be similar to those reported for the province as a whole (Figure 7). Much of the observed cancer rate reduction (all cancers combined) in Cape Breton results from a recent and significant reduction in the rate of prostate cancer, perhaps reflecting a post-screening effect: an exhaustion of the pool of pre-clinical cases or a cessation of aggressive screening (Cape Breton prostate rate: 28% lower than Nova Scotia or 38 fewer cases per 100,000; Figure 8). Rates of both lung and colorectal malignancies remain significantly higher in Cape Breton relative to Nova Scotia as a whole (19% higher or 18 more cases per 100,000 and 16% higher or 13 more cases per 100,000, respectively; Figures 9-10). Lung cancer rates were also significantly high in Cumberland, Inverness and Yarmouth counties and significantly low in Halifax and Lunenburg counties.

females - common cancer sites - Lower cancer incidence rates among females in Lunenburg County are largely due to lung cancer (23% lower than Nova Scotia or 13 fewer cases per 100,000; Figure 9). Rates of colorectal cancer in Lunenburg County are also significantly lower than the provincial average (13% lower or 9 fewer cases per 100,000; Figure 10). Rates of breast cancer in Lunenburg County are significantly higher than the provincial average (11% higher or 13 more cases per 100,000; Figure 11). Cancer rates among females in Cape Breton County have been historically high. For the first time, since at least 1985, rates in Cape Breton have been shown to be similar to those reported for the province as a whole (Figure 7). Much of the observed cancer rate reduction (all cancers combined) in Cape Breton results from a recent and significant reduction in the rate of breast cancer, perhaps reflecting a post-screening effect: an exhaustion of the pool of pre-clinical cases or a cessation of aggressive screening (Cape Breton breast rate: 15% lower than Nova Scotia or 20 fewer cases per 100,000; Figure 11). Rates of both lung and colorectal malignancies remain significantly higher in Cape Breton relative to Nova Scotia as a whole (19% higher or 18 more cases per 100,000 and 16% higher or 13 more cases per 100,000, respectively; Figures 9-10). Lung cancer rates were also significantly high in Cumberland, Inverness and Yarmouth counties and significantly low in Halifax and Lunenburg counties.

Table 4. Incidence counts and rates of invasive cancer among males, by county, Nova Scotia 2000-2004.

MALES

County	CANCER TYPE Prostate	Colorectal	Lung	Other	ALL CANCERS Total New Cases	Incidence Rate[1] per 100,000	95% Confidence Interval[2]
Annapolis	110	57	72	193	432	540.2	[488.8 - 591.6]
Antigonish	91	41	34	109	275	535.9	[471.4 - 600.4]
Cape Breton	320	307	356	749	1,732	533.8	[508.3 - 559.3]
Colchester	187	86	123	273	669	462.2	[426.8 - 497.7]
Cumberland	144	94	132	233	603	539.4	[495.5 - 583.3]
Digby	88	44	60	135	327	484.7	[431.4 - 538.1]
Guysborough	47	40	38	73	198	531.6	[456.5 - 606.6]
Halifax	1,228	670	646	1,840	4,384	522.2	[506.4 - 537.9]
Hants	139	97	114	232	582	519.1	[476.4 - 561.8]
Inverness	82	42	74	126	324	549.1	[488.4 - 609.8]
Kings	197	131	138	359	825	500.2	[465.8 - 534.7]
Lunenburg	253	134	127	349	863	522.3	[486.9 - 557.8]
Pictou	237	110	138	302	787	561.6	[521.8 - 601.5]
Queens	70	36	41	102	249	599.7	[524.4 - 675.1]
Richmond	65	34	28	75	202	546.1	[468.2 - 623.9]
Shelburne	82	34	52	83	251	498.6	[436.5 - 560.8]
Victoria	19	19	29	54	121	490.1	[401.5 - 578.8]
Yarmouth	94	70	93	178	435	522.2	[472.1 - 572.4]
All Nova Scotia 2000-2004[3]	**3,454**	**2,047**	**2,295**	**5,469**	**13,265**	**522.7**	**[513.7 - 531.6]**

[1] Rates are standardized to the age distribution of the 1991 Canadian population.
[2] The 95% confidence interval (range within which a value is expected to fall with a given probability).
[3] Includes some cases that could not be assigned to a specific county.

Table 5. Incidence counts and rates of invasive cancer among females, by county, Nova Scotia 2000-2004.

FEMALES

County	CANCER TYPE Breast	Colorectal	Lung	Other	ALL CANCERS Total New Cases	Incidence Rate[1] per 100,000	95% Confidence Interval[2]
Annapolis	90	50	35	141	316	356.9	[314.0 - 399.9]
Antigonish	68	38	26	85	217	334.6	[287.4 - 381.8]
Cape Breton	452	235	259	702	1,648	393.0	[373.2 - 412.9]
Colchester	176	102	94	275	647	373.3	[343.4 - 403.3]
Cumberland	142	83	79	227	531	383.6	[348.7 - 418.5]
Digby	67	46	53	128	294	365.7	[320.9 - 410.5]
Guysborough	42	14	24	63	143	357.8	[295.9 - 419.8]
Halifax	1,200	651	576	1,823	4,250	393.8	[381.7 - 405.9]
Hants	126	72	57	199	454	360.5	[326.6 - 394.4]
Inverness	77	41	44	135	297	428.3	[376.9 - 479.8]
Kings	181	113	102	296	692	351.3	[324.5 - 378.1]
Lunenburg	174	111	79	286	650	345.7	[317.8 - 373.6]
Pictou	173	84	92	297	646	364.5	[334.6 - 394.5]
Queens	62	27	27	83	199	420.4	[358.8 - 482.0]
Richmond	44	21	13	57	135	352.6	[289.7 - 415.5]
Shelburne	66	41	25	101	233	422.2	[366.2 - 478.3]
Victoria	32	19	18	34	103	370.6	[294.9 - 446.4]
Yarmouth	90	48	45	162	345	346.5	[307.9 - 385.0]
All Nova Scotia 2000-2004[3]	**3,264**	**1,797**	**1,649**	**5,099**	**11,809**	**380.1**	**[373.0 - 387.2]**

[1] Rates are standardized to the age distribution of the 1991 Canadian population.
[2] The 95% confidence interval (range within which a value is expected to fall with a given probability).
[3] Includes some cases that could not be assigned to a specific county.

Figure 7. Comparative incidence figures (CIF) based on age-standardized incidence rates (ASIR) comparing county to provincial level estimate, all invasive cancers, by sex, Nova Scotia 2000-2004. The rate of cancer in a given county varies significantly from that of the province if the 95% confidence intervals (|——|) of the CIF value ( ) do not cross the green reference line (i.e. NS estimate). ASIR that differ significantly from the provincial average are shown with an asterisk (*).

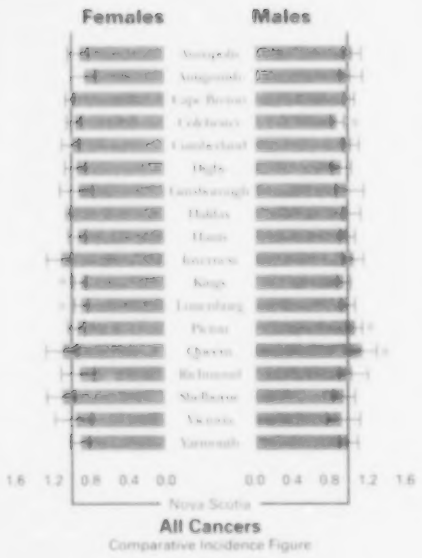


Figure 8. Comparative incidence figures (CIF) based on age-standardized incidence rates (ASIR), comparing county to provincial level estimate, invasive prostate and breast cancers, Nova Scotia 2000-2004. The rate of cancer in a given county varies significantly from that of the province if the 95% confidence intervals (|——|) of the CIF value ( ) do not cross the green reference line (i.e. NS estimate). ASIR that differ significantly from the provincial average are shown with an asterisk (*).

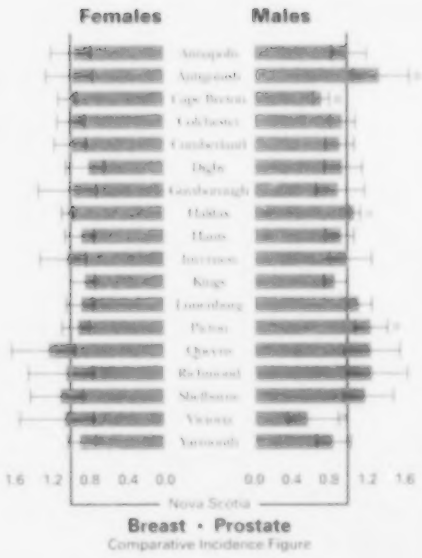


Figure 9. Comparative incidence figures (CIF) based on age-standardized incidence rates (ASIR), comparing county to provincial level estimate, invasive lung cancer, by sex, Nova Scotia 2000-2004. The rate of cancer in a given county varies significantly from that of the province if the 95% confidence intervals (|——|) of the CIF value ( ) do not cross the green reference line (i.e. NS estimate). ASIR that differ significantly from the provincial average are shown with an asterisk (*).

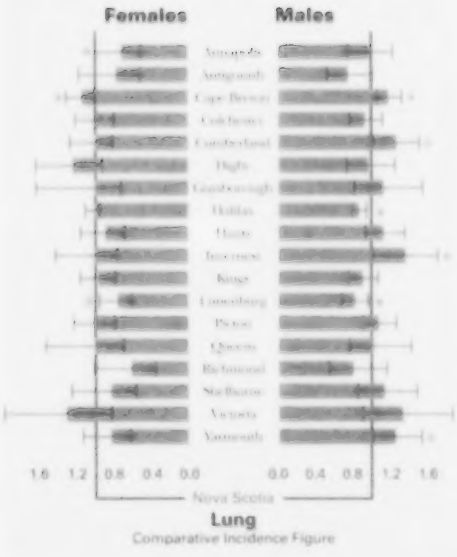
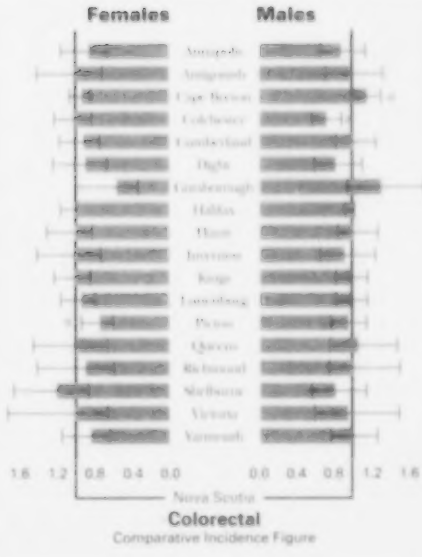


Figure 10. Comparative incidence figures (CIF) based on age-standardized incidence rates (ASIR), comparing county to provincial level estimate, invasive colorectal cancer, by sex, Nova Scotia 2000-2004. The rate of cancer in a given county varies significantly from that of the province if the 95% confidence intervals (|——|) of the CIF value ( ) do not cross the green reference line (i.e. NS estimate). ASIR that differ significantly from the provincial average are shown with an asterisk (*).



lower incidence than the provincial average: 12 cases per 100,000; Figure 9). Annapolis county also showed a low lung cancer incidence rate (29% lower than provincial average: 16 cases per 100,000), while Cape Breton County rates exceeded that of the provincial average. Lung cancer rates in Cape Breton have been high for at least a decade,[7] and are currently 16% (18 more cases per 100,000) above the provincial average. Low overall cancer rates in Kings County may reflect the lower rate of female breast cancer (13% lower than the provincial average; 11 fewer cases per 100,000 – although not statistically lower; Figure 8). Breast cancer incidence rates among women were comparable across counties although, rates in Queens County have remained among the highest in the province over the past 20 years, currently exceeding the provincial average by 25% (27 more cases per 100,000). Finally, colorectal cancer incidence rates among women were quite variable across counties; Pictou County was the only locality where rates differed significantly from the provincial average (Figure 10; 24% below average or 13 fewer cases per 100,000).

Incidence by District Health Authorities

Approximately 32% (annual average of 2,636 new cases) of all cancer incidences were diagnosed in Cape Breton District Health Authority (annual average of 804 cases) and Capital Health (annual average of 1,832 cases) the two largest agglomerations for the delivery of health care services in the province (Tables 6-7; Figure 6).

males – Among males, the rate of 'all cancers combined' observed across district health authorities fell mostly within the provincial average, with the exception of Colchester East Hants Health Authority where the rate was significantly lower (38 fewer cases per 100,000; Figure 11). However, the rate of prostate cancer was quite variable across DHAs, with Pictou County Health Authority, South Shore Health and Capital Health exhibiting higher rates relative to the provincial average (32, 19 and 9 more cases per 100,000, respectively), while Cape Breton District Health Authority demonstrated a significantly lower rate (35 fewer cases per 100,000; Figure 12). Regional variations in the rate of lung cancer were also observed: Cumberland Health Authority and Cape Breton District Health Authority exhibited rates significantly higher than the provincial average (24 and 20 more cases per 100,000, respectively); Capital Health exhibited rates significantly lower (10 fewer cases per 100,000; Figure 13). The rate of colorectal cancer was observed to vary significantly from the provincial average only in Cape Breton District Health Authority where the rate surpassed those of the province by 11% (9 more cases per 100,000; Figure 14).

females – Among females, the rate of 'all cancers combined' was comparable across the district health authorities, with the exception of Annapolis Valley Health where the rate was significantly lower (27 fewer cases per 100,000; Figure 11). The rate of 'other cancers' (namely cervical cancer)[8] and breast cancer tend to be low in this district (10 fewer cases per 100,000, respectively). In fact, the lowest rate of breast

Table 6. Incidence counts and rates of invasive cancer among males, by district health authority, Nova Scotia 2000-2004.

MALES	CANCER TYPE				ALL CANCERS		
District Health Authority	Prostate	Colorectal	Lung	Other	Total New Cases	Incidence Rate[1] per 100,000	95% Confidence Interval[2]
South Shore Health	323	170	168	451	1,112	538.5	[506.4 - 570.7]
South West Health	264	148	205	396	1,013	503.2	[471.8 - 534.6]
Annapolis Valley Health	307	188	210	552	1,257	514.9	[486.2 - 543.6]
Colchester East Hants Health Authority	252	140	179	390	961	484.5	[453.5 - 515.5]
Cumberland Health Authority	144	94	132	233	603	539.4	[495.5 - 583.3]
Pictou County Health Authority	237	110	138	302	787	561.6	[521.8 - 601.5]
Guysborough Antigonish Strait Health Authority	226	133	126	295	780	534.3	[496.3 - 572.3]
Cape Breton District Health Authority	398	350	433	891	2,072	533.6	[510.3 - 556.9]
Capital Health	1,302	713	704	1,955	4,674	519.9	[504.7 - 535.0]
All Nova Scotia 2000-2004[3]	**3,454**	**2,047**	**2,295**	**5,469**	**13,265**	**522.7**	**[513.7 - 531.6]**

[1] Rates are standardized to the age distribution of the 1991 Canadian population.
[2] The 95% confidence interval (range within which a value is expected to fall with a given probability).
[3] Includes some cases that could not be assigned to a specific county.

Table 7. Incidence counts and rates of invasive cancer among females, by district health authority, Nova Scotia 2000-2004.

FEMALES	CANCER TYPE				ALL CANCERS		
District Health Authority	Breast	Colorectal	Lung	Other	Total New Cases	Incidence Rate[1] per 100,000	95% Confidence Interval[2]
South Shore Health	236	138	106	369	849	360.9	[335.3 - 386.4]
South West Health	223	135	123	391	872	372.2	[346.3 - 398.2]
Annapolis Valley Health	271	163	137	437	1,008	352.8	[330.2 - 375.4]
Colchester East Hants Health Authority	246	131	121	366	864	373.4	[347.8 - 399.0]
Cumberland Health Authority	142	83	79	227	531	383.6	[348.7 - 418.5]
Pictou County Health Authority	173	84	92	297	646	364.5	[334.6 - 394.5]
Guysborough Antigonish Strait Health Authority	179	84	79	251	593	356.9	[326.8 - 387.0]
Cape Breton District Health Authority	536	284	305	825	1,950	395.3	[376.9 - 413.8]
Capital Health	1,256	694	606	1,931	4,487	391.0	[379.3 - 402.8]
All Nova Scotia 2000-2004[3]	**3,264**	**1,797**	**1,649**	**5,099**	**11,809**	**380.1**	**[373.0 - 387.2]**

[1] Rates are standardized to the age distribution of the 1991 Canadian population.
[2] The 95% confidence interval (range within which a value is expected to fall with a given probability).
[3] Includes some cases that could not be assigned to a specific county.

cancer was observed in Annapolis Valley Health between 2000 and 2004 (although not statistically significant). Regional variations in the rate of lung cancer were also observed among females, but only in Cape Breton District Health Authority were these differences significantly higher than the provincial average (15%; 8 more cases per 100,000; Figure 13). The rates of colorectal cancer among females were comparable across district health authorities, with the exception of Capital Health where the rates were slightly higher than the provincial average (5 more cases per 100,000) and Pictou County Health Authority where the rates were below average (13 fewer cases per 100,000; Figure 14). Rates of colorectal cancer in Guysborough Antigonish Strait Health Authority were also lower, but did not differ significantly from the provincial average. Colorectal cancer rates in this DHA are quite variable, largely due to Guysborough County where rates have been fluctuating considerably over time and between sexes. (Males exhibited much lower rates of colorectal cancer than females between 1995 and 1999,[16] relative to 2000-2004 for which rates among males appear to now exceed those of females).

Comments

A variety of factors may account for variation in the incidence of cancer across the province; therefore interpretation of even the largest differences must be done cautiously. Problems associated with random (chance) variations or bias (e.g. selective migration patterns) are often quite important when working with small geographic areas such as Nova Scotia.[17] Confidence in the observed patterns of cancer incidence may only be gained with continued monitoring. Cancer rates (all cancers combined) varied considerably in Guysborough, Richmond, Queens and Inverness counties between the 1995-1999 and 2000-2004 analyses. These counties share characteristics that increase variability in cancer rates: (1) they have small populations; and (2) their populations have been decreasing considerably over time (Figure 6). For example, Guysborough County has experienced a 20% reduction in population size since 1991. Continued population reduction of this scale may be indicative of selective migration patterns where healthier residents may be leaving the area seeking work and/or education, resulting in a population pool with a disproportionate number of potentially unhealthy people. If migration is sex specific, further disparity in cancer rates can occur. Out migration of people at lower risk of developing cancer (e.g. 49 years of age and younger, especially those younger than 29 years) has been observed to be significant in Nova Scotia over the past 15 years.[18] Other factors possibly accounting for geographic variation in cancer rates include varying levels of the utilization or implementation of screening and early detection programs such as mammography, prostate specific antigen (PSA) tests and cervical and colorectal cancer screening and; past exposure to cancer risk factors.

Figure 11. Comparative incidence figures (CIF) based on age-standardized incidence rates (ASIR), comparing DHA rates to provincial level estimate, all invasive cancers, by sex Nova Scotia 2000-2004. The rate of cancer in a given DHA varies significantly from that of the province if the 95% confidence intervals (⊢—⊣) of the CIF value ( ) do not cross the green reference line (i.e. NS estimate). ASIR that differ significantly from the provincial average are shown with an asterisk (*).

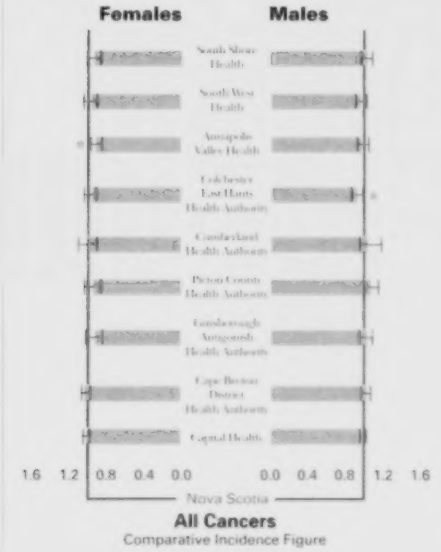


Figure 12. Comparative incidence figures (CIF) based on age-standardized incidence rates (ASIR), comparing DHA rates to provincial level estimate, invasive breast and prostate cancers, Nova Scotia 2000-2004. The rate of cancer in a given DHA varies significantly from that of the province if the 95% confidence intervals (⊢—⊣) of the CIF value ( ) do not cross the green reference line (i.e. NS estimate). ASIR that differ significantly from the provincial average are shown with an asterisk (*).

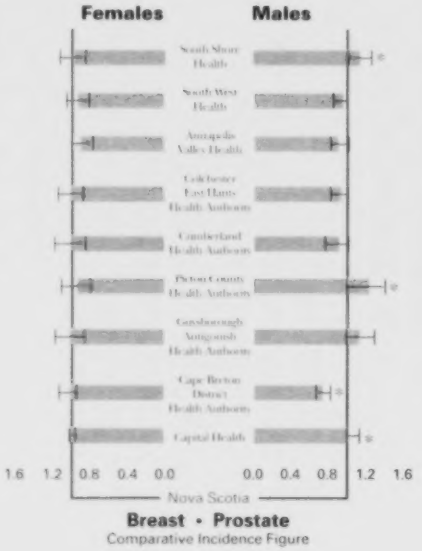


Figure 13. Comparative incidence figures (CIF) based on age-standardized incidence rates (ASIR), comparing DHA rates to provincial level estimate, invasive lung cancer, by sex Nova Scotia 2000-2004. The rate of cancer in a given DHA varies significantly from that of the province if the 95% confidence intervals (⊢—⊣) of the CIF value ( ) do not cross the green reference line (i.e. NS estimate). ASIR that differ significantly from the provincial average are shown with an asterisk (*).

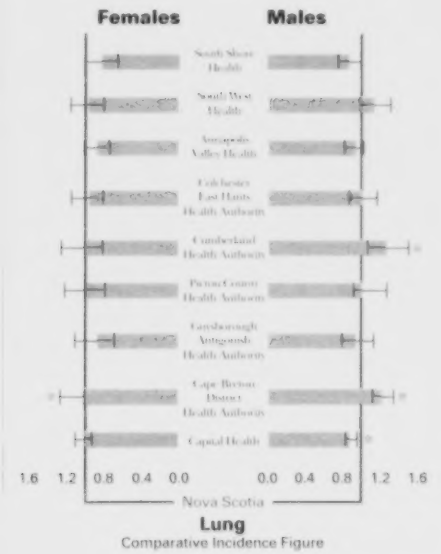
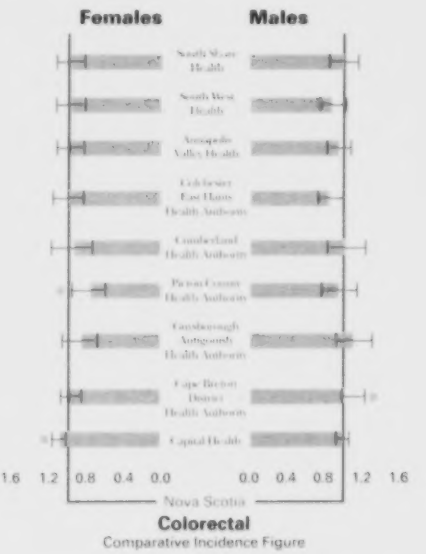


Figure 14. Comparative incidence figures (CIF) based on age-standardized incidence rates (ASIR), comparing DHA rates to provincial level estimate, colorectal cancer, by sex Nova Scotia 2000-2004. The rate of cancer in a given DHA varies significantly from that of the province if the 95% confidence intervals (⊢—⊣) of the CIF value ( ) do not cross the green reference line (i.e. NS estimate). ASIR that differ significantly from the provincial average are shown with an asterisk (*).



TIME TRENDS

Figure 15. Trends in age-standardized incidence (dark blue) and mortality (light blue) rates, all invasive cancers, males (A) and females (B), Nova Scotia 1971-2004. Fitted lines (solid lines) indicate general tendencies and asterisk (*) indicates year of a significant change in trend based on JoinPoint analysis.

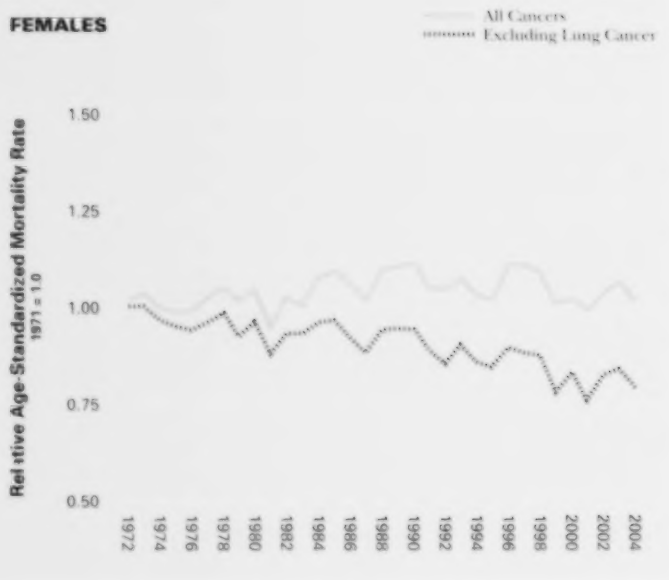
This section describes the observed patterns of cancer incidence and cancer-related mortality over time for the whole of Nova Scotia. Analyses include data for the period 1971-2004 with emphasis on common tumour types. Examination of time trends in cancer incidence and mortality can provide key information on the potential causes of cancer and the success (or lack thereof) of prevention and intervention efforts. However, trend analyses are complex, and a number of factors can influence the onset and outcome of cancer: exposure to risk factors (e.g., age, physical activity, diet, smoking, ionising or solar radiation, alcohol, drugs, parasites, viruses, environmental and/or occupational exposure), time lags in the manifestation of the disease, varying degrees of effort in detecting the disease, availability and improvements in therapies and interventions, variation in population structure due to selective immigration/emigration, variation in age-structure, lifestyle changes and education.

Cancer incidence rates for both sexes have increased since 1971 (Figure 15). Among males, rates increased 54.9% (335 to 519 cases per 100,000); among females rates increased 22.6% (305 to 374 cases per 100,000). Gender-related differences in the cancer incidence rates have gradually increased over time but have remained relatively constant over the past decade, with males being, on average 37%, more likely to be diagnosed with invasive disease than females. Both sexes have shown a reduction in the annual rate of increase over time.

Male mortality due to cancer increased 14.3% between 1971 and 2004. The rate reached its peak in 1992 when 284 cancer-related deaths per 100,000 were reported annually, and has since declined at a rate of 1.2% per year, to approximately 243 deaths per 100,000 (Figure 15). This trend was largely driven by mortality due to lung cancer, which decreased at a rate of 1.8% per year during the same period. Female mortality due to cancer has remained relatively stable since 1971, with an average of approximately 166 deaths per 100,000 per year (Figure 15B). An examination of the age-

standardized mortality rates from 1971 to 2004 for all cancer sites combined and for all sites excluding lung cancer shows that female cancer mortality for all sites other than lung cancer dropped 22.7 % during that period (Figure 16).

Figure 16. Trends in the relative change in age-standardized mortality rates including and excluding invasive lung cancer, females Nova Scotia 1971-2004.



MALES - COMMON CANCER TYPES

prostate cancer - For males, the most pronounced increase in incidence rate was for prostate cancer, more than doubling between 1971 and 2004 (from 58 to 137 per 100,000; Figure 17A). Prostate cancer incidence rates increased 6.3% annually between 1981 and 1991, a rapid shift corresponding largely to the increasing use of surgical techniques for the management of benign prostatic conditions (e.g., trans-urethral resection of the prostate or "TURP"[1,2]) and to the wide adoption of early detection procedures (especially for the period 1991-94) based upon the determination of PSA (Prostate-Specific Antigen) levels. As observed elsewhere in Canada, early detection may have depleted the pool of prevalent cancer in the population that was screened[3] and the trend has reverted to a rate of increase of 0.7% annually. In strict contrast, age-standardized mortality rates attributable to prostate cancer were increasing more gradually, at approximately 1.2% annually between 1971 and 1996. Since 1996, mortality has declined significantly at an annual rate of 5.0% , perhaps as a result of earlier detection or improved treatment or both.[3]

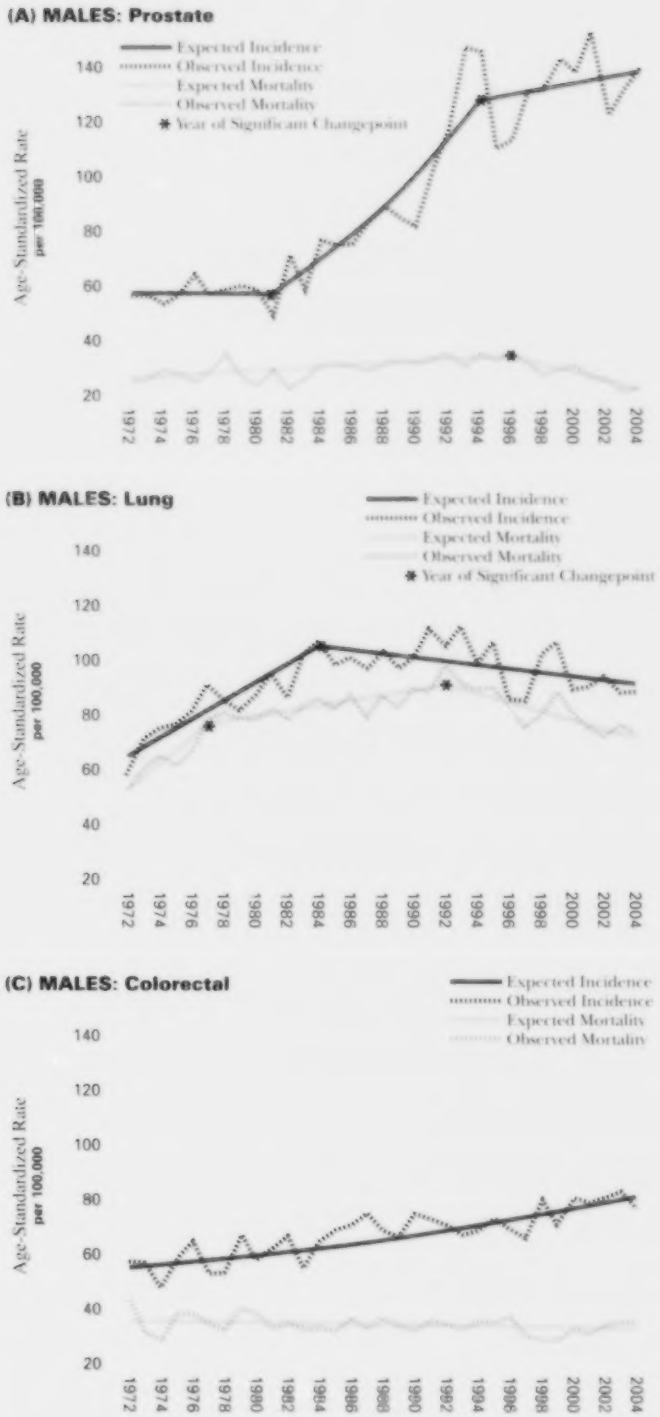
lung cancer - Lung cancer incidence rates increased 63.7% relative to 1971 (from 54 to 89 cases per 100,000; Figure 17B). Rates increased 4.0% annually between 1971 and 1984 and have since declined 0.7% annually, likely reflecting a reduction in male tobacco consumption in the mid-1960s.[3] As mentioned previously, lung cancer alone accounts for a third of cancer deaths in men, strongly influencing overall male cancer mortality. Mortality due to lung cancer has declined 24.2% between 1992 and 2004 (from 98 to 74 deaths per 100,000).

colorectal cancer - Colorectal cancer incidence rates for males increased 51.6% (from 51 to 77 cases per 100,000) between 1971 and 2004 (Figure 17C). Most of this increase was gradual, with rates increasing 1.2% annually. Mortality rates associated with colorectal cancer have remained relatively stable over the past 34 years, declining only slightly (0.3% annually) and accounting for an average of approximately 35 deaths per 100,000 per year (Figure 17C).

FEMALES - COMMON CANCER TYPES

breast cancer - Breast cancer incidence rates increased 21.3% relative to 1971 (from 84 to 101 cases per 100,000; Figure 18A). A slight decrease in rates was observed between 1971 and 1977 (1.2% annual reduction), followed by a 1.8% annual increase until 1998. Since 1998, breast cancer incidence rates declined 13.5% (from 117 to 101 cases per 100,000 per year). This decline is driven by a notable annual reduction of 3.3% in the rate of breast cancer among women aged 55-69 (Figure 19). Incidence among women, aged 55 and younger,

Figure 17. Trends in age-standardized incidence (dark blue) and mortality (light blue) rates, prostate (A), lung (B) and colorectal (C) invasive cancers, males, Nova Scotia 1971-2004. Fitted lines (solid lines) indicate general tendencies and asterisk (*) indicates year of a significant change in trend based on JoinPoint analysis.



also dropped at a rate of 0.8%; while among women aged 70 and older, incidence continued to increase 1.2% annually (Figure 19). The recent decline observed in the rate of invasive breast cancer among women aged 55-69 coincides with a continued steep increase in the proportion of in situ breast cancer diagnoses (Figure 20). These patterns may reflect sustained mammography screening efforts, detecting tumours at an early stage, prior to invasion beyond the epithelial layer. The incidence of in situ breast cancer has increased among all age groups since the late 1980s, but has done so more rapidly in women aged 55-69, part of the group targeted by screening mammography. It has also been suggested that the recent but sustained decline in the incidence of breast cancer may partly result from primary prevention through improved diet.[21,22] Whether changes in diet have significantly influenced the downturns observed in breast cancer incidence in Nova Scotia is unknown. However, a recent notable increase in the number of women aged 55-59 diagnosed with the disease (see Table 2 and Saint-Jacques et al 2002[16]) appear to mark the entry of the baby boomers into the breast cancer world, a cohort suspected to have favoured healthy life style choices for many years.[21,23]

Mortality attributable to breast cancer has declined steadily at a rate of 1.8% annually since 1987 (Figure 18A). Rates are now 11.6% lower than in 1987, accounting for 21 deaths per 100,000 in 2004 relative to 36 deaths per 100,000 in 1987. According to the National Cancer Institute of Canada, breast cancer mortality rates are at their lowest since 1950, with similar declines being observed in the United States, the United Kingdom and Australia.[1,25] Evidence suggests that the widespread and consistent use of effective breast cancer screening as well as the application of effective adjuvant systemic therapy both independently influence improvements in breast cancer outcomes.[1,21,26,27]

lung cancer - Increases in female lung cancer incidence and mortality rates have been rapid and significant over the past 34 years (Figure 18B). Lung cancer incidence rates increased from 9 cases per 100,000 in 1971 to 52 cases per

Figure 18. Trends in age-standardized incidence (dark blue) and mortality (light blue) rates, breast (A), lung (B) and colorectal (C) invasive cancers, females, Nova Scotia 1971-2004. Fitted lines (solid lines) indicate general tendencies and asterisk (*) indicates year of a significant change in trend based on JoinPoint analysis.

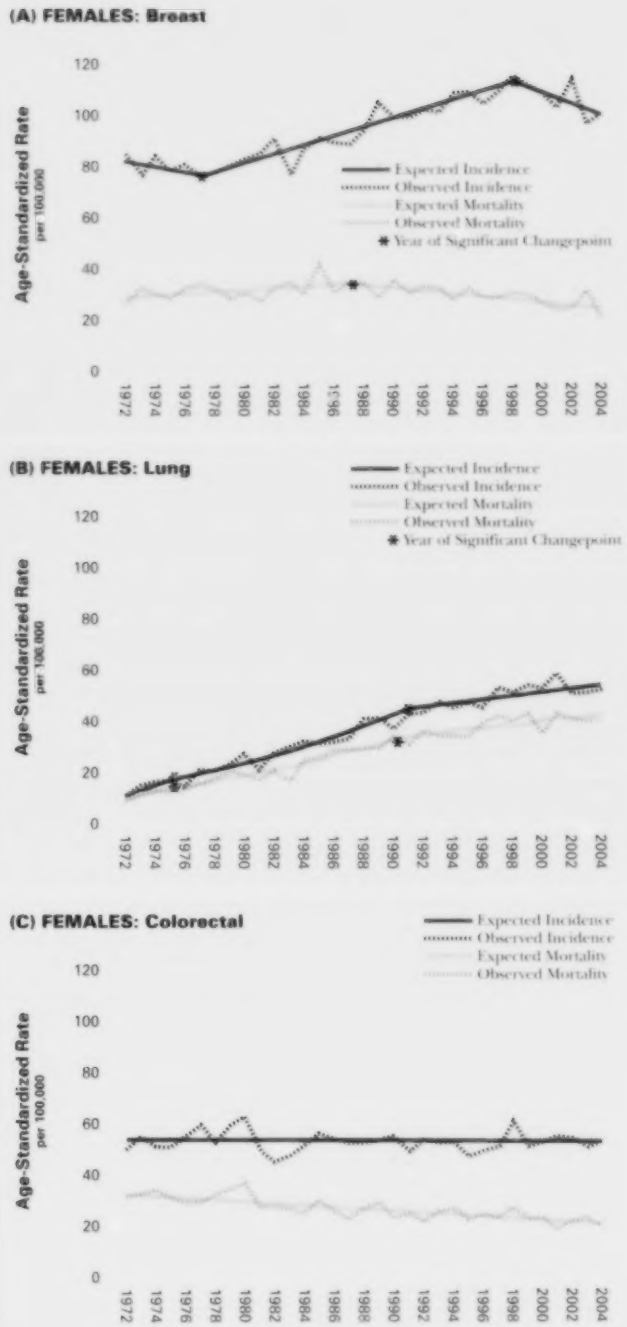


Figure 19. Trends in age-specific invasive breast cancer incidence rates (dotted lines), females, Nova Scotia 1980-2004. Fitted lines (solid lines) indicate general tendencies and asterisk (*) indicates year of a significant change in trend based on JoinPoint analysis.

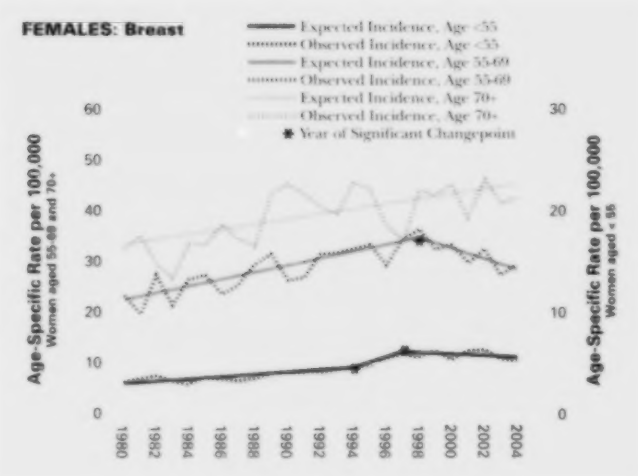


Figure 20. Trends for in situ breast cancer as a percentage of all breast cancers, females, Nova Scotia 1980-2004.

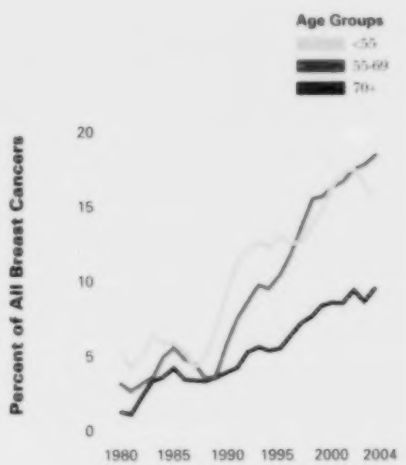
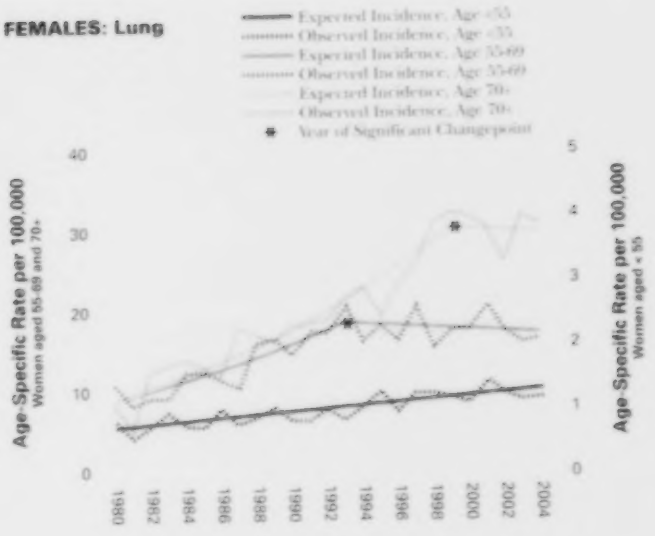


Figure 21. Trends in age-specific invasive lung cancer incidence rates (dotted lines), females, Nova Scotia 1980-2004. Fated lines (solid lines) indicate general tendencies and asterisk (*) indicates year of a significant change in trend based on JoinPoint analysis.



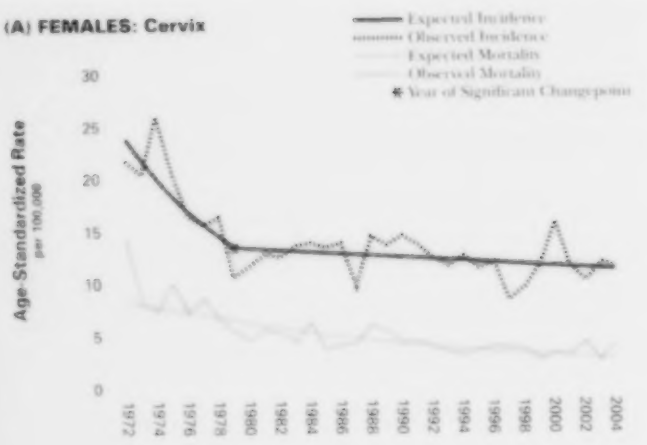
100,000 in 2004, resulting in a 181.5% increase in the incidence of the disease among Nova Scotia women. The rate of increase (slope of the trend) has declined gradually from 17.2% annual increase between 1971 and 1975 to 5.9% between 1975 and 1991. Since 1991, invasive lung cancer diagnoses increased 1.7% annually with the rate of increase varying significantly by age. For example, recent trends indicate that although rates continue to rise among women aged 55 years and younger (2.5% annual increase; Figure 21), they have stabilized among women aged 70+ (0.2% annual decrease) and appear to be dropping among women aged 55-69 (0.7% annual decrease). These trends are encouraging but have not yet resulted in a significant reduction in the overall rate of female lung cancer. In 2004 Nova Scotia women continued to be diagnosed with lung cancer at a rate nearly six times greater than they were in 1971. Tobacco consumption, especially tobacco smoking, has been recognized worldwide as a major determinant of lung cancer for several decades, accounting for nearly 80% of lung cancer deaths in men and 50% of lung cancer deaths in women.[7,8,9] Smoking rates among Canadian women began to decline slightly only in the mid-1980s, thus benefits in terms of declining lung cancer rates (all ages combined) have yet to become apparent.[7,10]

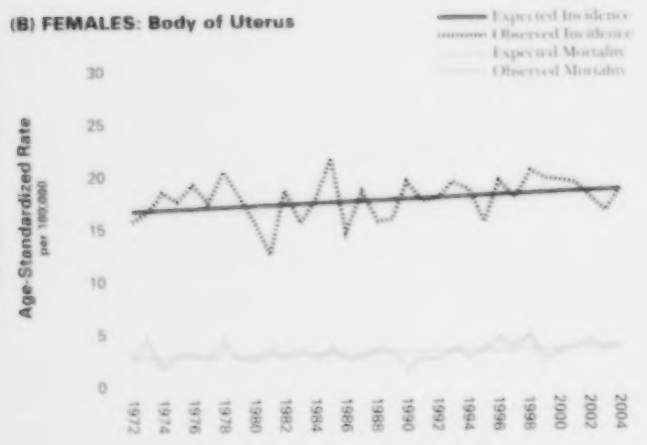
Trends in lung cancer mortality rates mirror those of incidence. Rates increased from 7 deaths per 100,000 in 1971 to 42 deaths per 100,000 in 2004, resulting in a 500% increase in the number of women dying from the disease (Figure 18B). Although mortality rates continue their increase among females, they do so at a slower rate since the early 1980s (1971-1975: 17.2% annual increase; 1975-1991: 6.0% and 1991-2001: 1.7%). Similar trends in both lung cancer incidence and mortality have been reported in other areas of the world.[11]

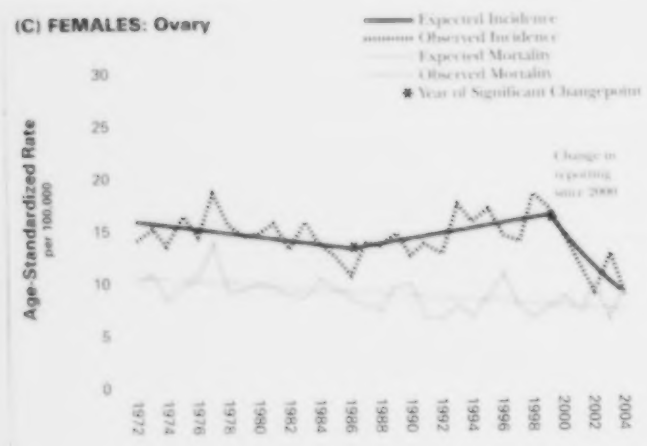
colorectal cancer – Colorectal cancer incidence rates among females have remained relatively stable between 1971 and 2004 (Figure 18C). A recent decline in colorectal cancer incidence rates has been reported at the national level, but rates in Nova Scotia, although 15.6% lower than in 1971, have yet to show a consistent and significant decrease. Mortality rates associated with colorectal cancer parallel more closely those of Canada as a whole, declining 14% since 1971 (from 37 cases to 20 deaths per 100,000; Figure 18C). Some evidence suggests that increased casual screening efforts, education, changes in lifestyle (e.g. diet, physical activity), and improved surgical interventions may be contributing to these trends.[12,13,14,15] Reduction in mortality rates for colorectal cancer was more pronounced for females than males.

other cancers – Trends for the incidence and mortality rates for cancers of the cervix, uterus and ovary are presented in Figure 22A-C. Mortality rates associated with cervical and ovarian cancers decreased 50.6% and 19.3%, respectively between 1971 and 2004, while those associated with uterine cancer remained relatively stable over time. The incidence rates of uterine cancer fluctuated from 12 to 22 cases per 100,000 annually. The incidence rates of ovarian cancer fluctuated between 8 to 18 cases per 100,000 annually and dropped significantly in recent years as also observed at the national level. This decline is attributable to a change in the coding of the disease in the year 2000 as opposed to a true change in the occurrence of ovarian cancer. This change does not affect the interpretation of mortality due to ovarian cancer. Downward trends in the incidence rates of cervical cancer have been observed since

Figure 22. Trends in age-standardized incidence (light blue) and mortality (light blue) rates, cervical (A), uterine (B) and ovarian (C) invasive cancers, females, Nova Scotia 1971-2001. Fitted lines (solid lines) indicate general trends and asterisk (*) indicates year of a significant change in trend based on JoinPoint analysis.







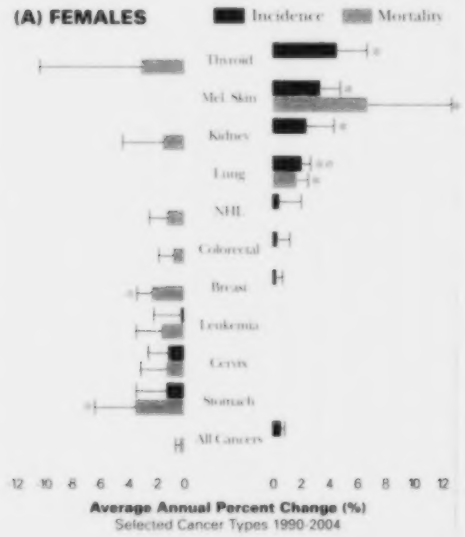
1971, with rates decreasing 54% between 1971 and 2004 (from 24 to 11 cases per 100,000). Rates decreased most rapidly between 1971 and 1979 (8.1% annual decline), a period coinciding with the broad adoption of cervical cytology screening tests (Papanicolaou or "Pap" tests) and the introduction of colposcopy services in Nova Scotia. The correlated, although more gradual (3.2% annual decline), decrease in mortality rates associated with cervical cancer suggests improvements in the early detection and perhaps, treatment of this disease.[1,2] Increased incidence rates in 1998 and 1999 likely reflect targeted efforts to screen "never screened" and "under-screened" women in Nova Scotia.

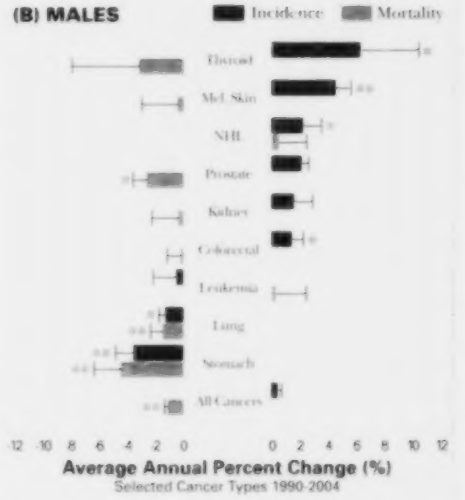
Comments

The rates of cancer incidence appear to have stabilized among Nova Scotians since 1990, with male and female rates increasing at an average of 0.4% and 0.7% annually, respectively (Figures 15 and 23). The levelling off of male cancer incidence rates has been observed since 1993, while that of females has been more recent (1989). Declines in mortality rates have been more pronounced among males than females since 1990, with rates decreasing annually 1.1% and 0.3%, respectively (Figure 23).

Overall trends in both cancer incidence and mortality are similar to those of Canada.[1] For example, thyroid and melanoma skin cancer incidence rates in both sexes are increasing most rapidly in both Nova Scotia and Canada (males: 6.2%, 4.4% annually, respectively; females: 4.6% and 3.4%, respectively; Figure 23). Stomach (both sexes; males: -3.6%; females: -1.3%) and cervical cancer (-1.1% annually, since 1990) incidence rates are declining rapidly in Nova Scotia as well as in Canada as a whole. However, some differences were evident between the provincial and national trends. In particular, male kidney cancer average annual percent change in incidence rates are greater in Nova Scotia than the national average (+1.7% vs +0.5%), although the 95% confidence intervals are also quite large.

Figure 23. Average annual percent change (AAPC) in age-standardized incidence and mortality rates, selected invasive cancers, females (A) and males (B), Nova Scotia 1990-2004. A 95% confidence interval (|——|) is presented for each estimate (significance levels are shown with an asterisk: * $p = 0.05$; ** $p = 0.01$). Estimates for thyroid and melanoma mortality are unstable as they are derived from small counts.





CANCER SURVIVAL

Cancer survival refers to the amount of time between first diagnosis and death of a cancer patient.[5,10] It is the realization of prognosis (Table 8) and is influenced by the type/location of cancer, the nature of the disease (e.g. rate of tumour development), the age of the patient and stage of the disease at diagnosis, the availability and effectiveness of treatment, variation in diagnostic techniques and prior health. This section describes the survival experience of Nova Scotians diagnosed with common invasive cancers (prostate, breast, lung or colorectal cancers) in the years 1997-2001 followed to 2004. Five-year survival is reported as a function of age, sex, cancer type and extent of the disease at diagnosis. To account for the age and sex dependence of survival ratios, survival is expressed relative to the background mortality rates of the general population, largely unaffected by cancer.

The five-year relative survival ratios were highest for prostate cancer, followed by breast, colorectal and lung cancer (Figures 24-25). Irrespective of the cancer type, survival ratios were consistently higher for patients diagnosed at an early disease stage (Figures 26-31). The stage of the disease at diagnosis is known to be an important and consistent determinant of cancer survival. Since staging information based on laboratory, radiological, clinical and surgical assessments was not available for the period of interest, a semi-quantitative localized-distant method scheme was used to report relatively crude, but nonetheless sensible, survival ratios by extent of disease (Table 9). The age of the patient at diagnosis was also observed to be an important determinant of prognosis. However, the relative influence of this variable varied considerably with the type of cancer and the time elapsed since diagnosis (i.e. differences observed between age groups one year post diagnosis may no longer be significant five years from diagnosis). Overall, relative survival tended to be poorer among those diagnosed at an older age, with the exception of breast cancer diagnosis for which survival ratios were considerably lower among younger women (Table 10). Lower survival at an older age has

Table 8. A measure of prognosis.

Survival ratios measure prognosis. They are influenced by the nature of the disease, the ability to cure the disease, as well as the stage/extent of the disease at the time of diagnosis. In cancer research, the prognosis of a patient may be categorized as following[5]:

Excellent prognosis	Five-year relative survival ratios ≥ 85 %
Good prognosis	Five-year relative survival ratios 70-84 %
Fair prognosis	Five-year relative survival ratios 30-69 %
Poor prognosis	Five-year relative survival ratios < 30 %

[5] McLaughlin JR, Sloan MR, Janoyjak DP. Cancer Survival in Ontario. Toronto: The Ontario Cancer Treatment and Research Foundation; 1995.

Table 9. Extent of disease at diagnosis[1].

Extent	Description
Local	A cancer confined entirely to the organ of origin
Regional	A cancer that has extended beyond the limits of the organ of origin into regional lymph nodes or directly into neighbouring tissue or organs
Distant	A cancer that has spread to other lymph nodes and/or metastasized to remote organs
Unknown	Information insufficient to assign the extent of the disease

[1] A Certified Health Record Technician assigns the extent of disease at the time of initial disease registration, with the assignment based on all available information (e.g., pathology reports, operative reports, diagnostic imaging reports and physician consultation reports).

Table 10 Age-specific relative survival ratios at one-, three- and five-years, common invasive cancers, by sex, Nova Scotia 1997-2001 followed to the end of 2001

		Relative Survival (%)[2]		
	AGE[1]	1 year	3 year	5 year
MALES				
prostate	[20-54]	100.0 [n/a]	96.9 [91.7, 99.3]	95.0 [88.4, 98.6]
	[55-69]	100.0 [99.0, 100.6]	98.8 [97.2, 100.2]	98.5 [96.1, 100.5]
	[70+]	98.0 [96.4, 99.3]	98.0 [95.5, 100.4]	98.3 [94.6, 101.8]
lung	[20-54]	43.9 [36.8, 50.8]	26.5 [20.4, 32.9]	23.7 [17.7, 30.2]
	[55-69]	36.0 [32.4, 39.6]	17.0 [14.2, 20.0]	13.1 [10.4, 16.1]
	[70+]	31.5 [28.5, 34.6]	15.4 [12.9, 18.1]	13.8 [11.1, 16.7]
colorectal	[20-54]	84.0 [77.8, 88.6]	73.4 [66.3, 79.4]	63.6 [55.5, 70.6]
	[55-69]	82.9 [78.9, 86.3]	66.5 [61.5, 71.1]	59.8 [54.2, 65.1]
	[70+]	72.3 [68.7, 75.7]	58.4 [53.9, 62.8]	52.3 [46.9, 57.8]
FEMALES				
breast	[15-39]	99.2 [94.4, 99.9]	84.3 [76.4, 89.7]	77.5 [68.6, 84.2]
	[40-49]	98.3 [96.5, 99.2]	94.9 [92.2, 96.7]	90.7 [87.2, 93.4]
	[50-69]	97.9 [96.8, 98.7]	92.4 [90.5, 93.9]	87.9 [85.5, 90.1]
	[70+]	94.4 [92.3, 96.1]	87.9 [84.7, 90.8]	83.4 [79.3, 87.3]
lung	[20-54]	45.5 [38.0, 52.6]	28.5 [22.0, 35.2]	24.4 [18.2, 31.1]
	[55-69]	44.5 [39.9, 49.0]	25.7 [21.8, 29.8]	18.0 [14.4, 22.0]
	[70+]	34.9 [31.3, 38.5]	17.6 [14.6, 20.7]	14.1 [11.2, 17.3]
colorectal	[20-54]	85.8 [80.0, 90.0]	75.2 [68.4, 80.8]	70.8 [63.6, 76.9]
	[55-69]	80.5 [75.7, 84.5]	68.6 [63.1, 73.6]	63.2 [57.2, 68.7]
	[70+]	70.3 [66.9, 73.6]	56.8 [52.8, 60.7]	53.8 [49.1, 58.4]

Where analyses were based on the cohort method (see Appendix B).
95% confidence intervals are shown in brackets. n/a denotes an instance where the information is not available.
[1] Age at diagnosis.

Figure 24. Five-year relative survival, invasive common cancers, males, Nova Scotia 1997-2001 diagnoses.

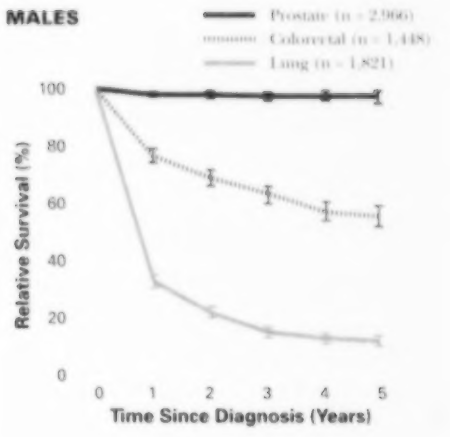
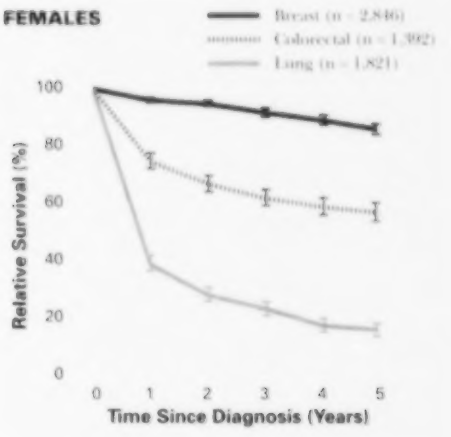


Figure 25. Five-year relative survival, invasive common cancers, females, Nova Scotia 1997-2001 diagnoses.



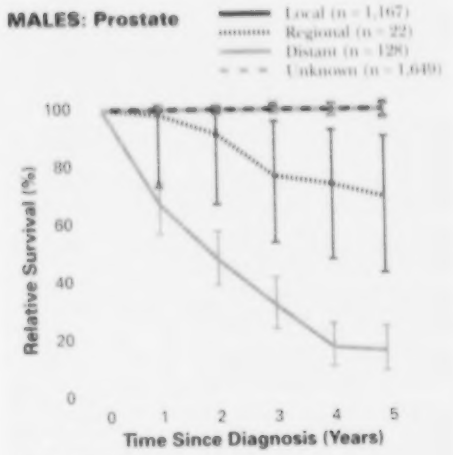
been attributed to factors such as the provision of less aggressive treatment due to high level of comorbidity, as well as less favourable stage distribution.[7]

prostate cancer - The five-year survival ratio for males diagnosed with prostate cancer was 98.3% [95% CI 96.2-100.4] of the survival rate of the general population (Figure 24; Table 11). These survivorship estimates are excellent (see Table 8), exceeding those reported at the national level for patients diagnosed in 1997 (Canada: 86.0% [95% CI 84.8-87.1]).[7] The cause of this difference is uncertain but may reflect a bias related to the widespread adoption of PSA testing (Prostate-Specific Antigen) initiated in the early 1990s and which continues to be used. The early detection of a large number of latent and/or indolent cases, or invasive but asymptomatic cases increases survival estimates as these patients will appear to live longer with the disease.[7] Unfortunately, it is not known if PSA testing was more widely used in Nova Scotia relative to Canada during the period of interest.

Among males diagnosed with prostate cancer, nearly all survived the disease when detected early at localized extent (Figure 26). The proportion dropped to a 17% five-year survivorship in those diagnosed with distant disease. Fortunately, the proportion of cases detected at an early disease stage far exceeds that of cases detected at a more advanced stage for which prognosis is poor (see 'n' values on Figure 26). Some studies have reported lower five-year relative survival ratios among young males aged 20 to 54, compared to males aged 70 and older.[4,29,30] Such a tendency, though not statistically significant, was observed among males diagnosed between 1992 and 1996,[31] but not for those diagnosed between 1997 and 2001 (see Table 10).

breast cancer - The five-year survival ratio for females diagnosed with breast cancer was 86.3% [95% CI 84.4-88.1] of the survival rate of the general population (Figure 25; Table 11). These survivorship estimates are slightly higher than those reported for women diagnosed between 1992 and 1996 (82.1% [95% CI 79.9-84.2]). This

Figure 26. Five-year relative survival, invasive prostate cancer, by extent of disease, Nova Scotia 1997-2001 diagnoses.



Local and Unknown:
Relative Survival greater than 100 has been truncated to 100

small but significant improvement may reflect increased screening efforts, better adherence to evidence-based treatment guidelines which ensures that Nova Scotian women access and benefit from the most current standards of care. As well, the number of women diagnosed with invasive breast cancer and referred to an organized, multidisciplinary cancer program has increased from 71% (1996) to 80% (2001) in recent years (CCNS, unpublished data), resulting in a larger proportion of patients benefiting from advances in adjuvant systemic and radiation therapies.

Differences in survivorship observed between women diagnosed in 1992-1996 vs 1997-2001 varied with follow-up time and age at diagnosis. Indeed, women from the more recent cohort experienced greater survivorship at three, and especially, five-years post diagnosis, but not at one year (i.e. comparing values Figure 25 to those reported in Saint-Jacques et al 2002[31]). This pattern may indicate that treatments impacting survival manifest over the longer term, and is consistent with observations from randomized controlled clinical trials examining the benefit of adjuvant therapy (Dr. Daniel Rayson, personal communication). Improved five-year relative survival between the two time periods, was observed among most age groups

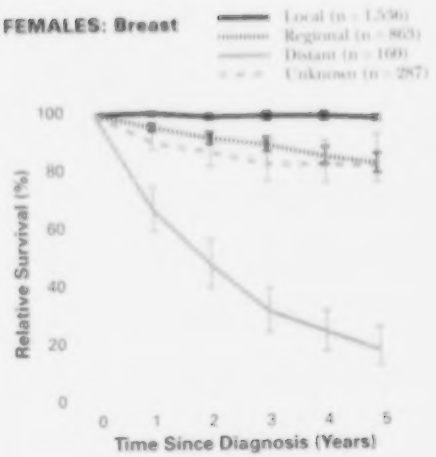
[95 % CI refers to the 95 % confidence interval (see Glossary).

Table 11 Five-year relative survival based on cohort and period methods, common invasive cancers, Nova Scotia

		Relative Survival (%)[1]			
		Cohort Method[2]		Period Method[3]	
Cancer Type	Sex	5-year	95 % CI	5-year	95 % CI
Prostate	Males	98.3	[96.2 - 100.4]	100.0	[98.0 - 103.8]
Breast	Females	86.3	[84.4 - 88.1]	86.9	[83.9 - 89.6]
Lung	Males	14.6	[12.7 - 16.5]	11.9	[9.4 - 14.8]
	Females	16.9	[14.7 - 19.1]	11.4	[8.8 - 14.4]
Colorectal	Males	56.3	[52.8 - 59.8]	53.7	[48.4 - 58.7]
	Females	58.5	[55.2 - 61.7]	63.6	[58.1 - 68.9]

[1] 95% confidence intervals are shown in brackets.
[2] Patients diagnosed between 1997-2001 with follow-up until death or end of 2001.
[3] Patients diagnosed between 1999-2001 with only the follow-up experience of 2001 being considered.

Figure 27. Five-year relative survival, invasive breast cancer by extent of disease, Nova Scotia 1997-2001 diagnoses.



(especially in pre-menopausal women), with the exception of women aged 70+ for whom the rates remained stable (see Saint-Jacques et al 2002[10] and Table 10).

The more current relative survival ratios based on period analyses[11] show that these excellent five-year survival estimates are maintained in women diagnosed more recently (1999-2004) for whom the five-year survivorship is estimated to be 86.9% (Table 11). Further improvements in breast cancer survival are anticipated with the development of more effective chemotherapy regimens, hormonal therapies and the use of immunotherapy such as Herceptin™ (Dr. Daniel Rayson, personal communication).

The stage of the tumour at diagnosis was an important determinant of patient survival (Figure 27). The five-year relative survival ratio for women diagnosed with local, regional or distant tumours was 96.8%, 81.6% and 19.2%, respectively. Importantly, the proportion of women with advanced breast tumours at presentation (6%) was considerably less than that for colorectal (18%) or lung cancers (34%). This early detection of breast cancers relative to other major cancers may be attributable to the development, organization and availability of the Nova Scotia Breast Screening Program combined with the fact that breast cancer is generally more easily detected at early stages compared to many other solid tumours.

The age of a patient at diagnosis was a secondary, although still important factor influencing prognosis. The five-year relative survival ratio for patients aged 15-39 was 77.5%, compared to 90.7%, 87.9% and 83.4% for patients aged 40-49, 50-69 and 70+, respectively (Table 10). These results are consistent with findings of other studies which also report lower survival ratios among very young women.[12-16] Lower survivorship in younger patients is not completely understood but has been associated with several potential factors including: (1) the biological nature of the disease – younger patients are more often afflicted with an aggressive and rapidly progressing cancer[17-20] and; (2) the density of the breast tissue – higher breast tissue density in younger women often impedes cancer detection by conventional mammography. In this report, it was observed that discrepancies in prognosis resulting from the age of the patient at presentation were only significant over the longer term. That is, all women had a comparable survival ratio at one year post diagnosis, but at five years post diagnosis, those of the youngest age group (15-39) were at a clear disadvantage.

[11] Period analysis is a method that produces more up-to-date estimates of long-term survival by exclusively reflecting the survival experience in the most recent period for which data is available (see details in Appendix B).

Figure 28. Five-year relative survival, invasive lung cancer, by extent of disease, males, Nova Scotia 1997-2001 diagnoses.

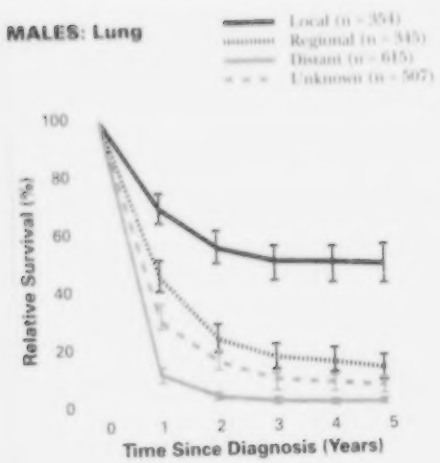
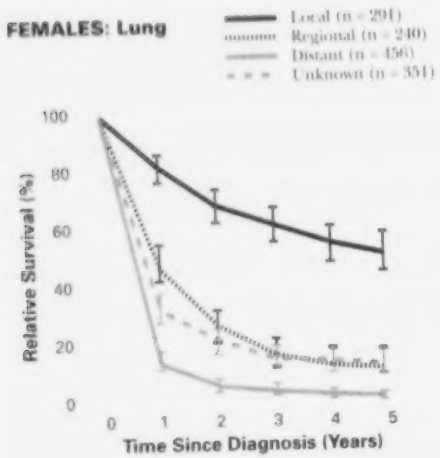


Figure 29. Five-year relative survival, invasive lung cancer, by extent of disease, females, Nova Scotia 1997-2001 diagnoses.



lung cancer - The five-year relative survival ratios for people diagnosed with lung cancer were low and are among the lowest in the country.[1] The five-year relative survivorship of males diagnosed between 1997 and 2001 was 14.6% and that of females was 16.8% (Figures 24-25). These estimates do not differ significantly from those experienced by people diagnosed over the earlier period of 1992 to 1996 (Males: 11.9% [95% CI 10.2-13.7%]; Females: 15.4% [95% CI 12.7-17.7%]; see Saint-Jacques et al 2002[10]). As was observed for other cancers, both the age of the patient and the stage of the disease at presentation strongly influenced survival outcome among lung cancer patients. Those diagnosed at an early disease stage or a younger age experienced slightly prolonged survival (Table 10; Figures 28-29). In Nova Scotia, the five-year relative survival ratio among either males or females aged 20-54 was nearly 75% greater than that of those diagnosed at age 70 or older (Table 10). The overall survival observed also varied according to the stage of the disease at presentation. For example, the five-year survival ratios among males diagnosed with local tumours was 48.6%, compared to 13.2% and 1.6% in those diagnosed with regional or distant tumours, respectively. Similarly, five-year survival ratios were 51.6%, 11.2% and 2.4% among females diagnosed with local, regional or distant diseases, respectively. Unfortunately, the largely asymptomatic nature of the disease in its early phase results in a large proportion of patients being diagnosed with advanced cancer for which curative treatment is unavailable (distant metastasis, 34%[*] relative to 18%, 6.0% and 4.3% for colorectal, breast and prostate cancers, respectively).

Survival outcomes based on the most currently available data indicate a recent decline in the five-year relative survival ratios experienced by women diagnosed between 1999 and 2004 (Table 11). Indeed, among females, the five-year relative survival ratio for women diagnosed between 1999 and 2004 was 11.4% (95% CI 8.8-14.4) compared to 16.9% (95% CI 14.7-19.4) for women diagnosed between 1997 and 2001. Such a significant decline has not been observed among males, although survival estimates for the 1999-2004 cohort do appear to be lower than those for the 1997-2001 cohort (see Table 11). The factors contributing to this recent decline are not well understood. However, a larger proportion of patients were diagnosed with distant disease during the later time period which in itself, would lead to lower survivorship among the most recent cohort.

[*] In addition, 27.2 % of lung cancer patients are diagnosed with "unknown disease stage" for which prognosis parallels that of patients diagnosed at a "distant disease stage".

Figure 30. Five-year relative survival, invasive colorectal cancer, by extent of disease, males, Nova Scotia 1997-2001 diagnoses.

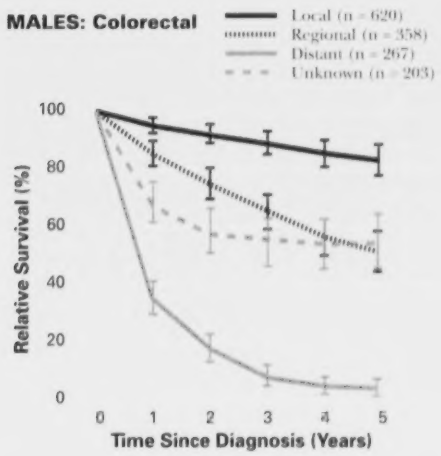
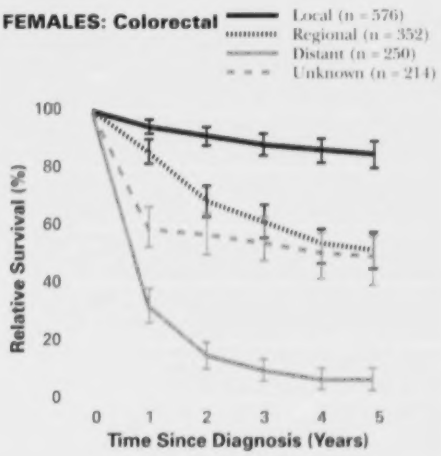


Figure 31. Five-year relative survival, invasive colorectal cancer, by extent of disease, females, Nova Scotia 1997-2001 diagnoses.



colorectal cancer - Based on a five-year relative survival ratio, prognosis is fair in people diagnosed with invasive colorectal cancer. The five-year relative survivorship of males diagnosed between 1997 and 2001 was 56.3% and that of females was 58.5% (Figures 24-25). These estimates do not differ significantly from those reported for people diagnosed in the earlier time period of 1992-1996 (Males: 56.3% [95% CI 52.8 - 59.8] vs 58.9% [95% CI 55.1 - 62.6]; Females: 58.5% [95% CI 55.2 - 61.7] vs 55.3% [95% CI 51.8 - 58.8]).

Again, the stage of the disease at presentation strongly influenced survival among colorectal cancer patients. Those diagnosed at an early disease stage benefited from significantly prolonged survival (Figure 30-31). Indeed, the five-year survival ratios among males diagnosed with local tumours was 83.2%, compared to 52% and 4.4% in those diagnosed with regional or distant tumours, respectively. Similarly, five-year survival ratios were 87.2%, 53.2% and 8.4% among females diagnosed with local, regional or distant diseases, respectively. The age of the patient at diagnosis also influenced prognosis, with the youngest patients aged 20-54, experiencing significantly longer survival ratios at one, three and five-years post diagnosis, compared to patients age 70 and older (Table 10).

"Data on cancer incidence and outcomes is vitally important for all aspects of clinical care and research. Knowing how outcomes are changing enables clinicians to continue to improve and adjust therapies to ensure Nova Scotians benefit from new developments in a timely manner. Good information is also essential to understanding how treatments are impacting survival. Clinical and epidemiologic research relies heavily on data to discover new cancer risk factors, understand patterns of disease and factors impacting prognosis in order to further develop programs and resources aimed at continually improving cancer care."

Dr. Daniel Rayson, ***Medical Oncologist, Capital Health Cancer Care Program***

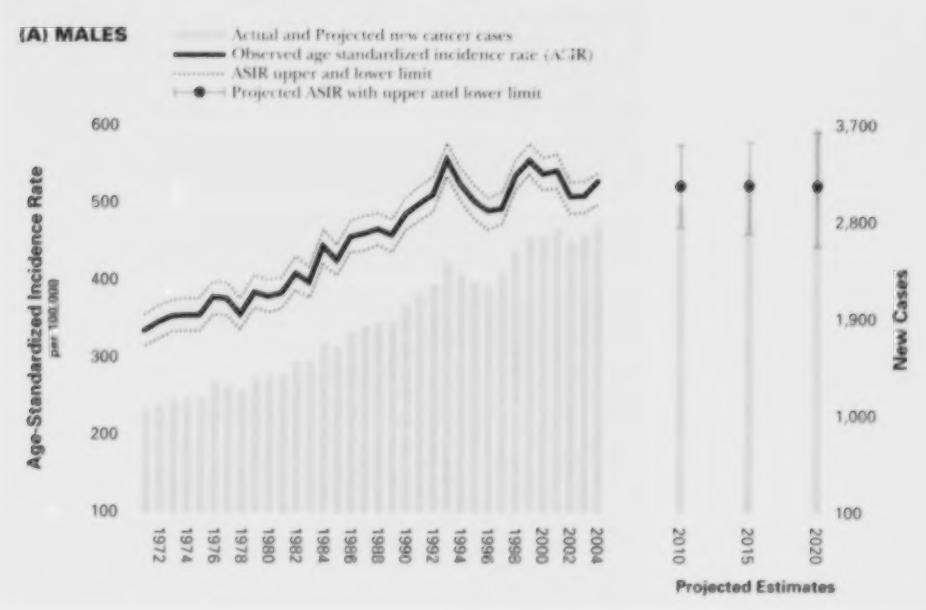
CANCER PROJECTIONS AND PREVALENCE

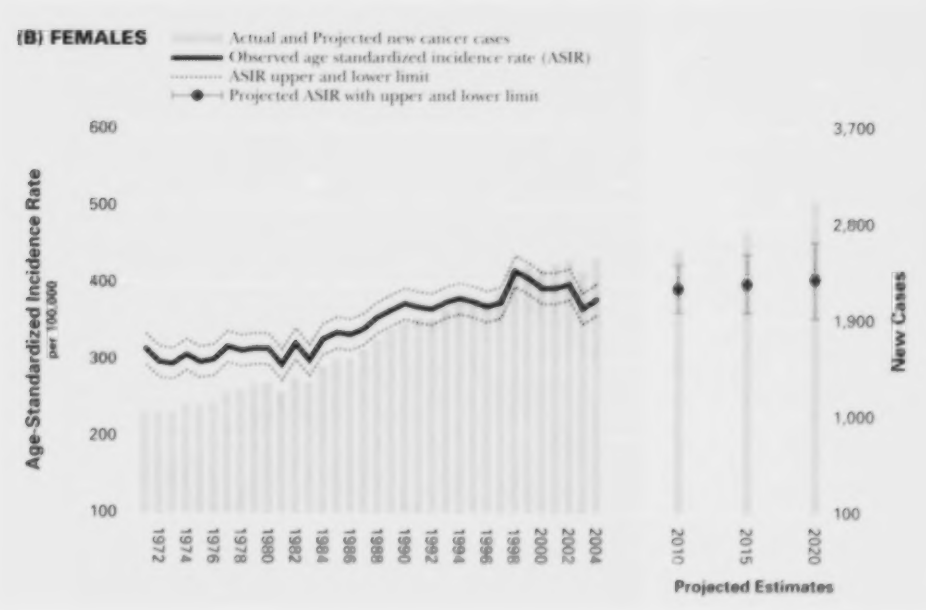
When forecasting cancer data, we assume that future trends will reflect recent trends. However, if there are changes in risk factors, introduction of a new screening modality or improvements in treatment outcomes, projections can be expected to differ from the values actually observed in the future. Trends in the number of new cancers and their age-standardized incidence rates are shown in Figure 32 along with projected estimates for the years of 2010, 2015 and 2020. Results show that age-standardized cancer incidence rates among males have leveled off since 1993 and are not expected to change in the near future (Figure 32A). Rates among women are expected to increase 6% by 2020 (from 375 to 398 cases per 100,000; Figure 32B). However, this anticipated increase may be smaller if rates among women continue to decline as observed in the most recent few years.

Trends in the number of deaths due to cancer and age-standardized mortality rates are shown in Figure 33 along with projected estimates for the years of 2010, 2015 and 2020. Cancer mortality rates have declined steadily among males since 1992 with the downtrend assumed to be maintained in future years (Figure 33A). Female cancer mortality rates are stable, although some decline may be anticipated if lung cancer, for which prognosis is poor, enters a definite downturn (Figure 33B).

While the rates of cancer incidence and mortality appear to increase or decrease only marginally, since the early 1990s, the numbers of people diagnosed with and dying from cancer continue to rise steadily (Figures 32-33). Just over 6,700 people are expected to be diagnosed in 2020. This represents an additional 1,569 new cases over the estimate for 2004 (35.6% increase among males; 25.7% increase among females). Changes in population size and age structure have been identified as the major determinants of the increased burden of cancer among Canadians.[14] In this province, most of the

Figure 32. Trends in incidence (new cases, right scale) age-standardized incidence rate (ASIR, left scale), all invasive cancers combined, males (A) and females (B), Nova Scotia 1971-2004. Dotted lines and (⊢—⊣) indicate 95% confidence intervals. Projected estimates for the years of 2010, 2015, 2020 are presented. Actual and projected new cases for selected cancer types are presented in Appendix C (Table C2).

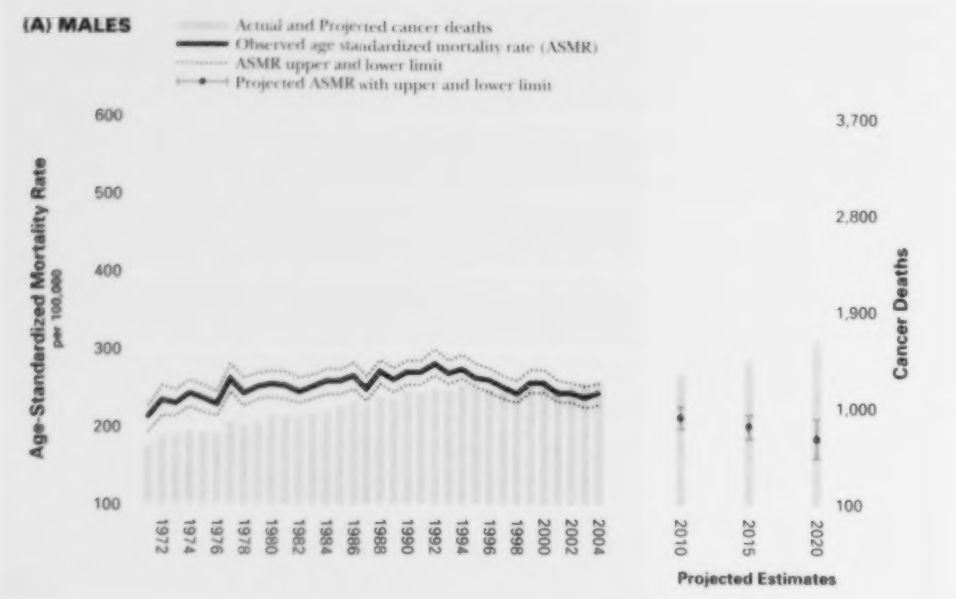


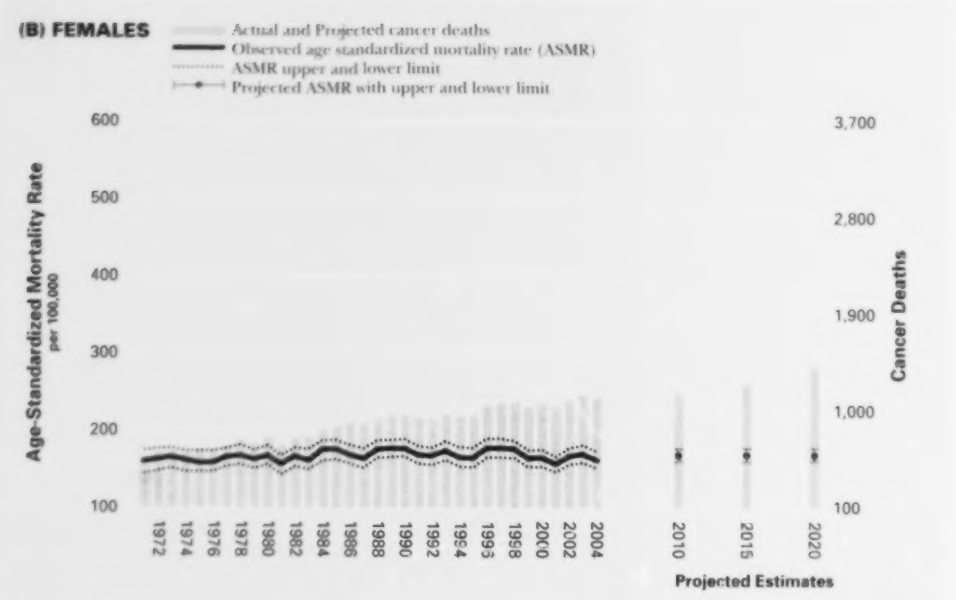


increase in cancer incidence can be attributed to a rapidly aging population (Figure 34). In 2020, 3,000 people are expected to die from cancer in Nova Scotia (29.7% increase among males; 26.9% increase among females relative to 2004).

Aging baby boomers will contribute to a disproportionately high number of cancer diagnoses resulting in a growing population of survivors living with a diagnosis of cancer. These individuals will create significant demands on the health care system, as they will require treatment, follow-up for cancer recurrence,

Figure 33. Trends in mortality (deaths, right scale) age-standardized mortality rate (ASMR, left scale) for all invasive cancers combined, males (A) and females (B), Nova Scotia 1971-2004. Dotted lines and (⊢—⊣) indicate 95% confidence intervals. Projected estimates for the years of 2010, 2015, 2020 are presented. Projected estimates for the years of 2010, 2015, 2020 are presented. Actual and projected cancer deaths for selected cancer types are presented in Appendix C (Table C3).





screening for independent secondary cancers and may be permanently impaired or disabled as a result of their cancer.[37] In the year 2004, just over 27,700 people were living with an invasive cancer diagnosis in this province (Table 12). That is, 1 in 34 Nova Scotians have had an invasive cancer diagnosed at some time during the previous 15 years. The most prevalent cancer types were prostate (5,411 men diagnosed) and breast (5,784 women diagnosed). Fewer people live with a lung cancer diagnosis due to the poor prognosis of the disease.

Figure 34. Trends in new cases attributed to cancer rate, population growth and population age structure, all ages, both sexes combined, Nova Scotia 1971-2004.

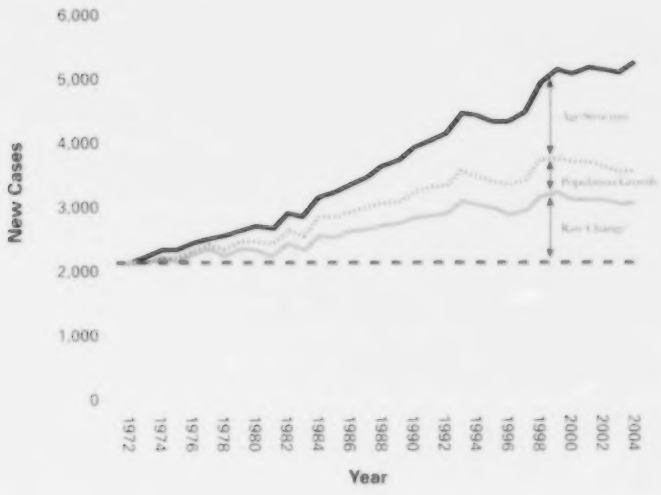


Table 12 Fifteen-year person and tumour based limited duration prevalence, common invasive cancers and all invasive cancers combined, Nova Scotia 1990-2004

	TOTAL		MALES		FEMALES	
CANCER TYPE	**Tumour -based**	**Person -based**	**Tumour -based**	**Person -based**	**Tumour -based**	**Person -based**
Colorectal	4,257	4,082	2,137	2,040	2,120	2,042
Lung	1,530	1,475	823	791	707	684
Breast	6,045	5,816	33	32	6,012	5,784
Prostate	5,411	5,411	5,411	5,411	n/a[1]	n/a[1]
All Cancers	**29,732**	**27,712**	**14,367**	**13,300**	**15,365**	**14,412**

[1] n/a, not applicable

Prevalence can also be used to refer to the number of cancers in a population, as a person can be diagnosed with more than one cancer in his/her lifetime.[1] This so-called "tumour-based prevalence" considers all primary cancers in a person, which if treated independently, may be more pertinent to the demand on health care. In the year 2004, just over 29,700 cancer cases prevailed in the province (Table 12). Nearly half of these cases had been diagnosed during the previous 5 years, placing great demands on our health care resources as short term intervals (2 and 5 years post diagnosis) include cases recently diagnosed, perhaps still in the primary treatment phase and requiring close monitoring or those cases in the terminal phase.[1,2,3]

Clearly, as the population grows and ages the number of people at risk of developing cancer continues to increase. As a result of earlier and improved diagnosis and treatment, more effective risk reduction and perhaps healthier lifestyles, patients are surviving longer, leading to a continuing increase in the number of people living with cancer.[1,2,3] This increase in both cancer incidence and prevalence among the population must be strategically addressed. A comprehensive cancer control strategy has been recommended to meet these growing demands.[1,2,3,4,5,6]

CANCER CONTROL

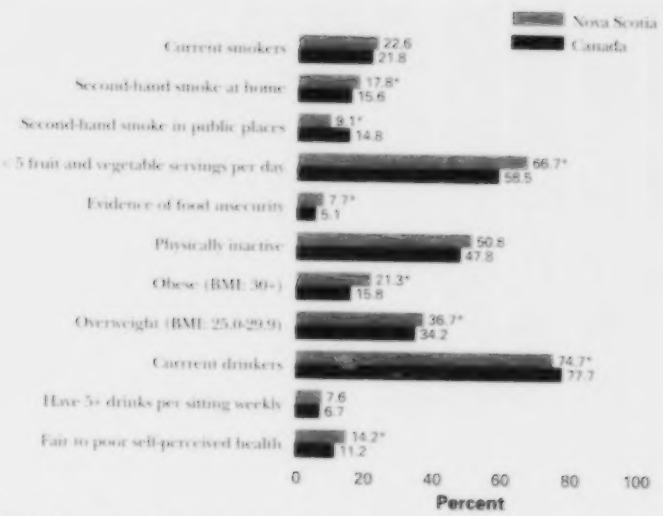
In Nova Scotia, we estimate that 23 people* are diagnosed daily with some form of the disease.[1] Historically, attempts to control cancer have been largely reactive, focusing almost exclusively on diagnosis and treatment. However, cancer control involves a continuum of potential interventions that includes disease prevention, screening, diagnosis, treatment, supportive care and palliative care.[27-29] A pro-active and comprehensive approach focusing on all components of the continuum, as well as the transitions that bridge these components, is necessary if cancer care is to be sustainable and viable.

Cancer Prevention

A comprehensive approach that encourages the adoption of healthy lifestyle choices and reduces potential social, behavioural and environmental cancer risk factors has been repeatedly identified as a necessary component of a comprehensive cancer control strategy.[27,30,31,32,33] In Nova Scotia, a number of provincial strategies have been established including Healthy Eating Nova Scotia; Active Kids, Healthy Kids; A Comprehensive Tobacco Control Strategy and the newly developed Chronic Disease Prevention Strategy. Promoting healthy living, addressing known risk factors and reducing the future burden of chronic diseases such as cancer are key targets within these strategies.

Cancer prevention aims at minimizing and eliminating modifiable risks that cause cancer. In developed countries, nearly 50% of all cancers are deemed preventable through the adoption of healthy eating habits, active and tobacco-free lifestyles and by avoiding exposure to ultraviolet rays and known environmental carcinogens and infectious agents.[34,35,36,37,38,39] Risk factors as such, are numerous and often engrained within our lives and must be considered within the context of the broader determinants of health (e.g. income, education, culture). Healthy lifestyle must become the norm in Nova Scotia. Currently, 22.6% of Nova Scotians smoke, 66.7% do not meet the daily recommended intake of fruit/vegetables, 50.8% are physically inactive and 58% are overweight/obese, yet 85.8% of the population consider themselves healthy (Figure 35).

Figure 35. Prevalence of modifiable cancer risk factors, Nova Scotia and Canada 2005.



Source: CCHS 3.1 (2005) except fruit and vegetable consumption estimate which comes from the CCHS 2.1 (2003).
* Represents a significant difference between Nova Scotian and Canadian estimate.

tobacco – Tobacco has long been recognized as a major cancer risk factor, accounting for approximately 30% of all new diagnoses and cancer-related deaths in the country.[1,32] Tobacco in all its forms (e.g. cigarette smoking, snuff, chewing tobacco) contains harmful, addictive substances.[32,33] Exposure to tobacco has been shown to increase the risk of several types of cancers, including lung, larynx, pharynx, oesophagus, mouth, lip, bladder, pancreas, kidney, stomach, colorectal, cervix and possibly, breast, liver, leukemia and multiple myeloma (Table 13).[1,34,35,37] Best known is lung cancer, where the personal use of tobacco products causes 80% of lung cancer in men and half of

*Estimate includes invasive (5,147 cases), in situ (847 cases) basal cell and squamous cell skin cancers (2,360 cases) diagnosed in 2004.

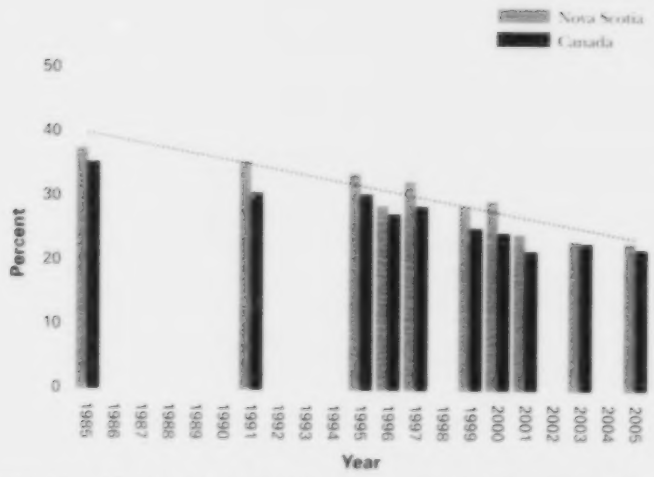
*Cancer is a collection of several diseases with detection occurring at various stages and over various histological subtypes, some of which are placing larger demands on our health care resources than others.

Table 13 Known modifiable risk factors and their association with various cancers.

CANCER RISK REDUCTION BENEFIT	PREVENTION STRATEGY					
	Avoid Tobacco	Eat a Healthy Diet	Be Physically Active	Maintain a Healthy Weight	Limit Alcohol	Avoid Excessive UV Rays Exposure
Bladder	✔	✔				
Breast		✔	✔	✔	✔	
Cervix	✔					
Colorectal	✔	✔	✔	✔	✔	
Kidney	✔			✔		
Larynx	✔	✔			✔	
Lung	✔	✔				
Oesophagus	✔	✔		✔	✔	
Oral	✔	✔			✔	✔
Pancreas	✔	✔				
Prostate		✔	✔			
Skin						✔
Stomach	✔	✔				
Uterus (excluding cervix)				✔		

Sources: Adapted from: 1) Canadian Cancer Society, National Cancer Institute of Canada. Canadian Cancer Statistics 2005. Toronto, Canada. 2005; 2) Institute of Medicine. Curry SJ, Berry T, Hewitt M (eds). Fulfilling the potential of cancer prevention and early detection. Washington, DC: The National Academic Press, 2003; and 3) Cancer Care Ontario. Insight on cancer. News and information on nutrition and cancer prevention. Toronto: Canadian Cancer Society (Ontario Division), 2003.

Figure 36. Percentage of current smokers, males and females aged 15+, Nova Scotia and Canada 1985-2005.



Sources: Gilmour J. Report on smoking in Canada, 1985 to 2001 (Statistics Canada, Catalogue 82F0077XIE) 2002. Canadian Community Health Survey Cycles 2.1 & 3.1.

lung cancer in women worldwide.[1,2] Clearly, most lung cancer diagnoses and deaths are avoidable.

Tobacco use has declined steadily in Canada as a result of decades of interventions, health promoting public policies, and growing knowledge around health risks. In 2005, 23% of Nova Scotians reported they smoked, down from 34% in 1995 and 37% in 1985 (Figure 36). Trends reported by the Canadian Community Health Survey[13] indicate a decrease in the percentage of current daily smokers as well as a decrease in the number of cigarettes smoked daily in this province. Reducing these numbers has been challenging and further reducing them will be an even greater challenge. Smoking remains more common among young adults, with the prevalence rising to 36.5%[14] among the 25-29 age group and then declining (Figure 37). Smoking is also more prevalent among those who have lower levels of income and education. The "quit smoking" message may be difficult to internalize, given the approximately 20-year lag time between exposure and the development of a lung cancer.

Environmental tobacco smoke (ETS) or second-hand (passive) smoking has also been recognized as an important cancer risk factor. Non-smokers who are exposed to second-hand smoke have a 20% to 30% greater risk of lung cancer than those not so exposed.[15] Second-hand smoke is also increasingly recognized as an important risk factor in breast cancer.[16] In 2005, the percentage of non-smoking Nova Scotians reporting to be regularly exposed to second-

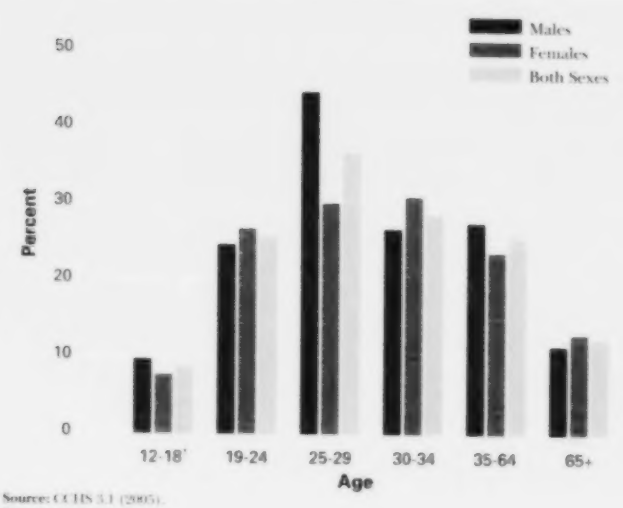
[14] *Smoking prevalence among males aged 25-29 goes up to 44.2 %.*

hand smoke at home was significantly higher than that reported for Canada as a whole (17.8% vs 15.6%, respectively); while exposure in public places was significantly lower (9.1% vs 14.8%; Figure 35). Overall, 12% of Nova Scotians reported that smoking in their workplace was completely unrestricted in 2005. Nova Scotia is working to address these long standing issues through a provincial tobacco control strategy in place since 2001.

diet - Diets high in saturated fats and low in fruits and vegetables have been associated with increased risk of a large number of cancers including bladder, breast, colon, oesophagus, larynx, lung, oral, pancreas, prostate and stomach cancers (Table 13).[2,5,23] In 2005, only 33% of Nova Scotians met the recommended intake of 5 to 10 servings of fruits and vegetables per day (Figure 35). Those who had recently experienced food insecurity[xiv] were less likely to report eating 5 to 10 servings of fruit and vegetables as were daily smokers or men. A provincial healthy eating strategy is now in place to promote consumption of fruits and vegetables among Nova Scotians and increase availability of these foods in community, work, school and health care settings. Additionally, the strategy seeks to improve access to and affordability of fruit and vegetables for low income populations.[33]

physical activity - Physical activity has been associated with reduced risk of developing colorectal and breast cancers (Table 13).[2,3,11,36] Some studies have also shown a probable risk reduction for prostate cancer,[2,27,37,38] but causality has not been consistently demonstrated.[39,40] People observed to be physically less active also tend to eat fewer fruits and vegetables and are at an increased risk of obesity, which in itself is another risk factor for cancer.[3,41] In 2005, 51% of Nova Scotians reported being inactive[xv] (Figure 35). This rate of physical inactivity is among the highest in the country.[2,27] Women, smokers and Nova Scotians from the oldest age group or in the lowest income category have been observed to be least active.[11,27]

Figure 37. Smoking prevalence by age and sex, Nova Scotia 2005.



Source: CCHS 3.1 (2005).
* Report with caution.

obesity and overweight - The prevalence of unhealthy weight is also high in Atlantic Canada. In Nova Scotia, 37% of people aged 18+ rated themselves as overweight and 34% rated themselves as obese (Figure 35). According to the International Agency for Research on Cancer, unhealthy weight accounts for over 25% of colon, endometrial, kidney, oesophageal and postmenopausal breast cancer cases worldwide (Table 13).[2,4,42] Obesity rates in Canada have been increasing over time,[27] with the youngest children now observed to have higher body mass index than older children.[2,43] A higher proportion of obese children are physically inactive and live in low-income families.[22]

alcohol - Drinking two or more standard drinks per day raises the risk of oral cavity, pharynx, larynx and oesophageal cancers, predominantly in those who also smoke heavily (Table 13).[2] Heavy alcohol consumption causes cirrhosis of the liver, and consequently, an increased risk of liver cancer.[23] It has also been identified as a risk factor for breast cancer in women and possibly colorectal cancer, especially in men.[2,23] Roughly 75% of Nova Scotians are current drinkers. Of

[xiv] *Food insecurity has been defined as the ability of all people, at all times, to access nutritious, safe, personally acceptable and culturally appropriate foods, produced (and distributed) in ways that are environmentally sound and socially just.*[33]

[xv] *Where physical inactivity refers to less than 15 minutes of moderate exercise, or < 1.5 kkl/day.*

those, 7.6% drink heavily with more than five drinks per sitting per week (Figure 35). According to these recent 2005 figures, alcohol consumption in Nova Scotia does not differ significantly from that reported for Canada as a whole.

other modifiable risk factors - Data relating to the exposure of Nova Scotians to infectious diseases, ultraviolet (UV) radiation and known environmental carcinogens are not available. However, a growing number of studies show causality between these risk factors and the incidence of cancer worldwide. Infectious agents such as human papilloma virus, hepatitis B virus and the Helicobacter pylori bacterium are thought to account for 18% of cancer worldwide, increasing respectively, the risk of cervical, liver and stomach cancers.[5] Some evidence supports an association between environmental carcinogens and an increased risk of cancer.[6] For example, consistent evidence supports an association between air pollution, radon exposure and lung cancer; asbestos and mesothelioma; as well as arsenic in drinking water, water disinfection by-products and bladder cancer.[7,8,9]

UV radiation causes several types of skin cancer, the most common form of cancer among humans. The most common source of UV radiation is the sun, although artificial sources such as tanning lamps and beds also emit UV radiation considered carcinogenic.[7] The majority of skin cancers are non-lethal (basal and squamous cell skin cancers) but nonetheless, require prompt care. In Nova Scotia, basal and squamous cell skin cancer accounted for nearly 2,360 diagnoses in 2004. Melanoma skin cancer is less common, but more dangerous. Sunburn during childhood is an important factor. Estimated 2006 age-standardized incidence rates of melanoma of the skin in Nova Scotia were the highest of the country, along with those of Prince Edward Island.[1] The causes of these high rates are unclear. A sun-safe strategy, which includes applying sunscreen regularly, wearing sunglasses, hats and protective clothing, staying out of the sun at midday, and providing shade structures for outdoor venues, is critical to reducing incidence[10] *(www.who.int)*.

Cancer Screening

Screening is another essential component to cancer control which attempts to detect cancer or its precursors early in the disease development, before symptoms appear. It has proven value in reducing premature mortality and morbidity through the early detection of certain cancers at a stage when treatment is most effective. Screening for various cancers is offered either through organized programs or on an opportunistic basis. The implementation of population-based screening depends on the natural history of the disease, the availability of effective early treatment options, and evidence of benefits and cost-effectiveness.[11,12,13,14] Scientific evidence currently supports population-based screening for cervical, breast and colorectal cancers.[7] Two large screening trials in Europe and the United States are currently evaluating the effectiveness of screening to reduce mortality from prostate cancer.[7] Interest in screening for other cancers such as cancer of the lung, liver, testis and ovaries continues to grow, but currently available tests have been largely ineffective.[15]

breast cancer - According to the International Agency for Research on Cancer (IARC), high quality mammography screening offered on an ongoing and timely basis, through organized screening programs could potentially reduce mortality due to breast cancer by as much as 25%.[16] An organized, population-based biennial screening program for breast cancer was established in Nova Scotia in 1991, expanding to full provincial coverage over time. Screening by clinical breast examination (CBE) and mammography currently target women aged 50-69 for which benefits have been demonstrated. The participation rate was 43% in 2004 (vs 34% for Canada as a whole) which is below the nationally established target of 70%.[16] However, over 80% of those women screened were re-screened within 30 months. This 'retention rate' exceeded the nationally established target of 75%. A high retention rate is important as any

The relationships between asbestos and mesothelioma, and radon exposure and lung cancer were originally established through occupational studies, and confirmed in environmental/residential studies.[6]

benefit of a single screen is time-limited: cancer may develop even after several normal screens have been achieved. Maintaining the ongoing participation of women is essential to ensure benefits and cost-effectiveness.[27] In Canada, compliance to screening mammography has been reported to be lower in women that have lower education levels, are single, unemployed or were born outside of North America, Europe or Australia.[27]

cervical cancer - Effective cervical screening programs, with expert cytology and high compliance, could potentially reduce the risk of developing invasive cervical cancer by more than 90%.[27] Cervical screening by Papanicolaou (Pap) smear is currently recommended within three years of initiation of sexual activity or at age 21. Pap tests can detect precancerous lesions and asymptomatic early stage cervical cancers, both of which can be treated successfully to prevent the progression of disease to a more advanced stage. There is little doubt that screening for cervical cancer has resulted in substantial downturns in both the incidence of the disease and associated mortality.[1,9,21]

In Nova Scotia, age-standardized incidence and mortality rates have declined 54% and 50.6%, respectively between 1971 and 2004 (Figure 22A). Nova Scotia instituted an organized population-based cervical cancer screening program in 1991 but Pap tests have been offered opportunistically for over 30 years in this province. The participation rate for triennial screening was 66% in 2004,[9] a proportion that remains below the provincial target of 85%. The Cervical Cancer Prevention Program (CCPP) has been successful at retaining participants with over 80% of women returning at least once within a five-year period, ensuring benefits and cost-effectiveness.[27] The adoption of liquid-based cytology (LBC), a variant of the conventional Pap test,[28] is being examined in Nova Scotia. LBC has the added benefit of potential to test for human papilloma virus DNA as well as detection of precancerous lesions. In addition, the province is currently exploring the adoption of the recently approved vaccine for the human papilloma virus. In Canada, compliance to recent cervical screening has been reported to be lower in women of low socio-economic status, in Aboriginal women and those born outside North America, Europe or Australia.[27]

colorectal cancer - Regular screening with fecal occult blood test (FOBT) could potentially reduce mortality due to colorectal cancer by about 20% when offered on an ongoing and timely basis.[27,29,30,31] As bowel cancers can bleed, the FOBT is used to detect small amounts of blood in stool, which can lead to a diagnosis of the disease at an earlier stage, when treatment is often most effective. FOBT could also lead to the detection of precancerous bleeding polyps that could be promptly removed.[1,32]

Follow-up for a positive test could include a double contrast barium enema (an x-ray of the large intestine), and more invasive and potentially risky procedures such as colonoscopy or sigmoidoscopy. Several associations, including the Canadian Association of Gastroenterology, the Canadian Digestive Health Foundation, the Canadian Cancer Society and the National Committee on Colorectal Cancer Screening, support the implementation of an organized, population-based approach to colorectal cancer screening to ensure biennial FOBT in those individuals at an average risk (50 years of age and over). However, evidence of benefits and cost-effectiveness for population-based colorectal screening continues to be studied in this country.[33] Currently, colorectal cancer screening is only offered on an opportunistic basis to those with high risk profiles such as those with first-degree relatives with the disease, a family history that suggests a definable genetic abnormality, familial adenomatous polyposis (FAP - a condition associated with the presence of hundreds, or even thousands, of colonic polyps) or long-standing colonic inflammatory bowel disease or symptoms.[34]

prostate cancer - Screening is offered on an

[27] *Females aged 18 and over.*

[28] *Some of the advantages associated with LBC include: greater sensitivity, equivalent specificity and a high proportion of satisfactory specimens.*

opportunistic basis in Canada. Organized population-based screening programs have yet to be recommended or implemented, in part due to the low premature mortality associated with the disease, the lack of an appropriate treatment for the preclinical lesions, the lack of evidence of effectiveness,[42,72] and the heterogeneous clinical nature of the disease (some prostate cancer being aggressive but most being slow growing, requiring little or no intervention). The main screening tests include digital rectal examination (DRE), transrectal ultrasonography (TRU) and level of serum markers such as prostate specific antigen (PSA) and acid phosphatase. While screening for prostate cancer remains a contested subject, Canada has witnessed increasing PSA testing since the early 1990s. To date, there has been insufficient evidence to suggest better outcomes or overall better quality of life in those that have been screened.

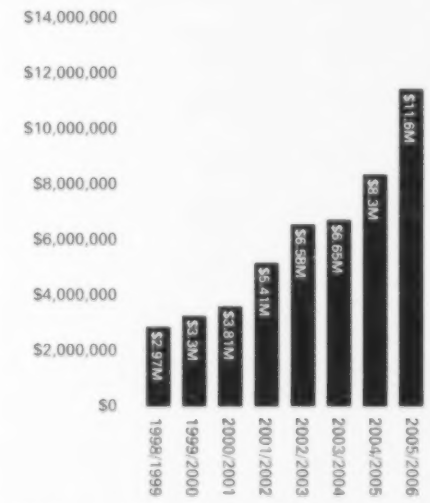
Cancer Treatment

Surgery (including biopsies), chemotherapy and radiotherapy represent the primary forms of cancer treatment available today. They are tools that continue to be refined with advances in research, technology and an overall better understanding of the disease. Surgery is required to establish the diagnosis in almost all cancers and is the primary form of therapy in almost half of all diagnoses.[73] Nearly one-half of all cancer patients are also treated with radiation therapy at some point in the trajectory of their disease. An even larger number of patients are treated with chemotherapy, including those offered hormonal treatment to manage breast or prostate cancers.[74]

In Nova Scotia, roughly half of all patients diagnosed with invasive cancers, are referred to one of the two provincial cancer centres[xiii] within six months of diagnosis for consideration of systemic adjuvant (chemotherapy/hormonal therapy) or radiation therapies. Referral patterns however, vary by diagnosis. For example, in 2004, only 36% of prostate cancer patients received a referral to a cancer centre compared to 80%, 52% and 64% of those diagnosed with breast, colorectal or lung cancers, respectively.

Treatment is increasingly complex. Multimodal approaches to treatment with increasing precision in their application, have become standard. The use of high precision radiotherapy; neoadjuvant[xiv] chemotherapy; adjuvant chemotherapy post-surgery; better use of organ-preserving surgical approaches; and perhaps, improved coordination between treatment modalities, are now an integral part of modern multidisciplinary cancer management. For example, chemotherapy now embraces a broader range of modalities which include antineoplastics, biologicals, hormonal therapy, and immunotherapy treatments. Some of this complexity has led to better outcomes – reduced morbidity with more individuals being treated for longer periods of time, more surviving and living with a cancer diagnosis. Improvements in treatment modalities can be expensive. For example, the estimated cost of chemotherapy in Nova Scotia has tripled over the past six years (from 3.81 million in 2000-01

Figure 38. The cost of chemotherapy, Nova Scotia 1998-2006.



Source: Nova Scotia Provincial Drug Distribution Program, Nova Scotia Pharmacare Program and IMS Co.

[xiii] *There are currently two provincial cancer centres in Nova Scotia: the Nova Scotia Cancer Centre located in Halifax and the Cape Breton Cancer Centre, located in Sydney.*

[xiv] *An adjunctive therapy given prior to definitive surgical treatment.*

to 11.6 million in 2005-06; Figure 38). This cost represents 85% of the total cancer drug cost in this province and could rapidly increase with the adoption of new, effective, but expensive drugs and the utilization of existing drugs expanding into new indications (e.g. Taxol®, Taxotere® Larry Broadfield, Personal Communication). As the number of newly-diagnosed patients and cancer survivors continues to rise, so too will the demand for diagnostic, treatment, follow-up and supportive care services. Prolonged wait times to access cancer care are currently reported for Nova Scotia and elsewhere, reflecting a growing imbalance between demand for care provision and system capacity.[22,25,26,27,28,29,30] An integrated and coordinated approach that would further emphasize disease prevention is needed to ensure the future sustainability and viability of our health care system.

Supportive and Palliative Care

Cancer supportive care ensures the provision of services required to meet the physical, social, emotional, nutritional, informational, psychological, spiritual and practical needs of patients.[31,32] These needs may emerge throughout the spectrum of the cancer experience - from diagnosis through treatment or follow-up phases, encompassing issues of survivorship, recurrence, palliative care and bereavement.

Patient Navigation, a program developed by *Cancer Care Nova Scotia* in 2001,[33] provides support to cancer patients and their families as they journey through the increasingly complex cancer system. In five of the nine health districts, cancer patient navigators work with family physicians, community-based specialists, oncologists and other cancer health professionals to coordinate services for the patient, acting as a link between the patient and the cancer system. They ensure that patients and their families receive timely information, knowledge and support. They guide patients to access supportive and rehabilitative care, palliative care, volunteers and other supports in their home communities. Over the twelve-month period from July 2005 to June 2006 1,074 individuals enrolled in the program (*CCNS*, unpublished data).

As the prognosis and needs of patients change, patients may be offered palliative care. Palliative care offers a wide range of services, including a support system that enables patients to lead a full life until death, psychological and spiritual care, pain and symptom relief, and a bereavement support system for families and friends. The program, offered throughout the province to varying degrees, primarily services those patients with a terminal cancer diagnosis. With the aging of the Nova Scotia population, an increasing number of people will be diagnosed with cancer. Supporting, improving and expanding palliative care services will be critical to ensure that all those in need receive the services they deserve.

Family members have, traditionally, been the primary providers of palliative care. Formalized palliative care programs have been available in Canada for just over 30 years, with programs beginning in Nova Scotia's two major urban centres, Halifax and Cape Breton Counties in 1988. Palliative care is currently offered in various settings (e.g. hospital, home, long-term care, home for specialized care etc.) throughout the province. The number of patients enrolled annually[xvi] in Cape Breton County has tripled (from 78 to 257 enrolments) over a 10-year period, and that in Halifax County has nearly doubled (from 295 to 554 enrolments; Table 14). In 2003, lung cancer patients, for which prognosis is poor, accounted for roughly 26% of the total number of cases enrolled in programs servicing Cape Breton and Halifax counties; those diagnosed with breast, colorectal and prostate cancers accounted 11%, 14% and 4%, respectively. The participation rate of the Cape Breton and Halifax programs has been stable since 1998 with approximately 76% of those

[xv] *Patient Navigation is currently available in 5 of the 9 health districts of the province: South Shore Health, South West Health, Annapolis Valley Health, Pictou County Health Authority and Guysborough Antigonish Strait Health Authority. All districts continue to be serviced by community support (e.g. clinical social workers, Canadian Cancer Society, support groups etc.).*

[xvi] *Access to electronic data is currently limited to Cape Breton and Halifax Counties.*

dying of cancer using the service. These are encouraging findings highlighting the need of terminal cancer patients to access such services. Supportive and palliative care is an important component of the cancer control continuum as it ensures the integration, coordination and continuity of care for patients, at a critical time in their lives. Current studies on palliative care in Nova Scotia attempt to address issues relating to disparity in access.[1,2,3]

Table 14 Enrollment in palliative care services for those who have died from cancer, Cape Breton and Halifax counties, Nova Scotia 1994-2003

HALIFAX COUNTY

Year of Death	All cancers Count	Breast Count (%)[2]	Colorectal Count (%)[2]	Lung Count (%)[2]	Prostate Count (%)[2]
1994	295	28 (9.5)	46 (15.6)	90 (30.5)	20 (6.8)
1995	329	39 (11.9)	43 (13.1)	98 (29.8)	16 (4.9)
1996	372	49 (13.2)	41 (11.0)	92 (24.7)	25 (6.7)
1997	406	41 (10.1)	53 (13.1)	110 (27.1)	29 (7.1)
1998	499	59 (11.8)	60 (12.0)	134 (26.9)	36 (7.2)
1999	405	48 (11.9)	53 (13.1)	109 (26.9)	31 (7.7)
2000	413	44 (10.7)	56 (13.6)	97 (23.5)	24 (5.8)
2001	432	38 (8.8)	56 (13.0)	120 (27.8)	14 (3.2)
2002	456	30 (6.6)	65 (14.3)	136 (29.8)	16 (3.5)
2003	554	65 (11.7)	84 (15.2)	142 (25.6)	22 (4.0)

CAPE BRETON COUNTY

Year of Death	All cancers Count	Breast Count (%)[2]	Colorectal Count (%)[2]	Lung Count (%)[2]	Prostate Count (%)[2]
1994	17	0 (0.0)	1 (5.9)	3 (17.6)	0 (0.0)
1995	78	14 (17.9)	12 (15.4)	15 (19.2)	4 (5.1)
1996	201	16 (8.0)	33 (16.4)	71 (35.3)	15 (7.5)
1997	241	23 (9.5)	31 (12.9)	66 (27.4)	9 (3.7)
1998	253	24 (9.5)	36 (14.2)	72 (28.5)	8 (3.2)
1999	165	17 (10.3)	20 (12.1)	48 (29.1)	12 (7.3)
2000	211	26 (12.3)	26 (12.3)	60 (28.4)	13 (6.2)
2001	232	20 (8.6)	28 (12.1)	60 (25.9)	5 (2.2)
2002	182	14 (7.7)	17 (9.3)	51 (28.0)	11 (6.0)
2003	257	25 (9.7)	31 (12.1)	68 (26.5)	9 (3.5)

Patient enrollment in Cape Breton County is incomplete for 1994-1995.

For example, of the 295 cancer decedents enrolled in palliative care services in 1994, 9.5 % had an invasive breast cancer diagnosis, 15.6 % had an invasive colorectal diagnosis etc.

SUMMARY

"The Canadian Cancer Society is committed to an evidence-based approach to our work. Before developing our health messages and position statements, we undertake a thorough review of the body of evidence, review information from other credible organizations, consult with external experts as needed, and then our expert team analyzes the information. Having a good understanding of the impact cancer has had in Nova Scotia and Canada enables us to tailor our programs, services and advocacy efforts to meet the needs of the people we serve."

Maureen Summers, *Executive Director, Canadian Cancer Society – Nova Scotia Division*

Understanding Cancer in Nova Scotia - outlines the impact of cancer on our people.
In Nova Scotia, we estimate that 23 individuals are diagnosed daily with some form of cancer; a number that will continue to increase with our rapidly aging population. The burden of the disease is real as is the challenge faced by the health system to provide and plan for care. Equally challenging and important is the need to broaden our focus from 'illness-management' to also emphasize a 'wellness-approach' that supports our people and communities to adopt a healthier way of living.

A pro-active and comprehensive approach focusing on all components of the cancer continuum from prevention to palliation, as well as the transitions that bridge these components is necessary if cancer care is to be sustainable and viable. Achieving this goal will require multi-level interventions involving both our social and health care systems where inequities in health and social status are addressed. Understanding and quantifying the impact of cancer risk factors and inequalities that may exist among Nova Scotians is critical for effective cancer control.

Choices supporting a healthy lifestyle must become the norm for Nova Scotians, at work, home and play. Creating and maintaining an environment conducive to healthy lifestyle choices will require adequate and sustained resources. Nova Scotia has already shown strong leadership in the area of tobacco control, including effective policy decisions, and the knowledge and skill gained from this endeavor must be transferred to other areas of risk reduction. Reducing the number of Nova Scotians who will be diagnosed with cancer in the future is a real possibility if health promotion truly becomes a way of life.

GLOSSARY

Age - The specific age at which a cancer is diagnosed (incidence) or at which a cancer death (mortality) occurs.

Age distribution See age structure.

Age-specific incidence count The number of new cases of cancer diagnosed during a period of time for a specified age-range. Five and ten year age groups are commonly used.

Age-specific incidence rate The ratio of age-specific incidence count to the population size from which the counts were derived. It is usually expressed as a rate, in units of: per 100,000 persons per year for a specified age range.

Age-specific mortality count The number of deaths (due to cancer) for a specified age range. Five and ten year age groups are commonly used.

Age-specific mortality rate The ratio of age-specific mortality count to the population size of a specified age range from which the counts were derived. It is usually expressed as a rate, in units of: per 100,000 persons per year, for a specified age range.

Age standardization The adjustment of a quantity (e.g., cancer incidence or mortality rates) to reflect the age structure of a reference population, allowing meaningful comparisons over time and between geographic areas. The age structure of all of Canada (from the 1991 population) was used as a standard (reference point) to facilitate comparisons with other regions of Canada.

Age-standardized Pap screening participation rates Pap participation rates standardized to the reference state of the 1991 Canadian age distribution. As Pap screening is strongly associated with age, Pap screening participation rates must be adjusted to impose a similar age structure on the population of interest to allow the comparison of rates between geographical regions and over time. See also, age standardization.

Age-standardized incidence rates Cancer incidence rates standardized to the reference state of the 1991 Canadian age-distribution. As cancer is more common in older people, a population that is older will show higher cancer incidence rates than one composed of younger individuals. Age-standardized incidence rates are calculated to allow the comparison of cancer rates between geographical areas and over time. See also, age standardization.

Age-standardized mortality rates Cancer mortality rates standardized to the reference state of the 1991 Canadian age-distribution. As cancer mortality rates vary strongly with age, mortality rates must be adjusted to allow their comparison between geographical areas and over time. See also, age standardization.

Age structure The frequency distribution (i.e., number) of people in a population as a function of their age.

Average annual percent change The rate of change observed in a trend, expressed as a percent increase or decrease, and averaged over a specified time period.

Cancer incidence count The number of new cases of cancer diagnosed during a period of time.

Cancer incidence rate The ratio of the cancer incidence count to the population size from which the counts were derived (unadjusted for age-structure). It is usually expressed as a rate, in units of: per 100,000 persons per year. Also referred to as the "crude incidence rate".

Cancer mortality count The number of deaths due to cancer.

Cancer mortality rate The ratio of the cancer mortality count to the population size from which the counts were derived (unadjusted for age-structure). It is usually expressed as a rate, in units of: per 100,000 persons per year. Also referred to as the "crude mortality rate".

Cancer prevalence The number of people who are currently living with cancer. In this report, estimates include all Nova Scotia residents known to be alive and diagnosed with invasive cancer within the preceding 15 years (i.e. 15 years limited duration prevalence, see Appendix A).

Cancer prevention Cancer prevention focuses on minimizing and eliminating modifiable risks that cause cancer. Some of the known risks include tobacco use, poor diet, obesity, lack of physical activity, alcohol use, risky sexual activity, exposure to ultraviolet rays, exposure to occupational and environmental carcinogens and infectious processes.

Colposcopy A microscopic examination of the cervix performed for the diagnosis of cervical abnormalities.

Comparative incidence figure (CIF) The ratio of the age-standardized incidence rate of a given tumour site (e.g., cervix) in a specific geographical area (e.g., a county or a District Health Authority, DHA) relative to that of the whole of Nova Scotia. A CIF less than one indicates incidence rates that are less than the provincial average, while a CIF greater than one indicates higher rates of cancer incidence than the provincial average.

Comparative Pap smear participation figure (CPSPF) The ratio of the age-standardized Pap screening rate recorded in a specific geographical area (e.g., a county or a District Health Authority, DHA) relative to that of the whole of Nova Scotia. A CPSPF less than one indicates screening rates that are less than the provincial average, while a CPSPF greater than one indicates higher rates of screening than the provincial average.

Confidence interval (CI) The numerical range within which a value is expected to fall with a given probability (expressed as a percentage; e.g., 95% CI).

Confounder A characteristic that could alter a person's risk of disease and be related to the risk factor under study.

Cytology Diagnostic procedure based on the study of cells using a microscope. An example of this procedure is the Pap smear, used to detect changes in cells that may lead to cervical cancer.

District health authorities (DHAs) Organizational units, defined by the provincial Department of Health, that integrate the delivery of health care services. DHAs govern, plan, manage, deliver, monitor, evaluate and fund the health services devolved to them. There are nine DHAs in Nova Scotia whose boundaries more or less mirror the already established county, or municipal lines (in some cases more than one county; see Figure 7).

Etiology Cause(s).

Five-year relative survival rate The probability of living beyond the first five years after being diagnosed with a primary invasive cancer, relative to that of members of the general population who have the same characteristics, such as age, sex, and province of residence, as the cancer patients.

Invasive cancer The uncontrolled growth of normal cells resulting in the formation of a malignant tumour that invades underlying tissues. Can be a primary or secondary cancer.

In situ cancer A malignant tumour strictly confined to the top layer of tissues (epithelium).

Lead-time bias An apparent, but not real, increase in survival can occur due to the detection of a disease at its preclinical stage (asymptomatic). This may result from the introduction of a screening program and/or increased sophistication of diagnostic methods. An apparent increased survival time for those patients can result from a knowledge of the disease for a longer period of time due to its early detection, rather than a true longer survival time.

Length bias Persons affected by slowly progressing disease have a longer preclinical stage (asymptomatic period) and are therefore more likely to be identified by a screen. When a screening program is introduced, it will detect a larger proportion of less aggressive cases who typically experience longer survival. This will create a bias of increased survival, particularly in the early years post-introduction of a screening program.

Logarithmic transformation A mathematical procedure applied to data that reduces the influence of extreme values and so increases the relative "normality" of data and therefore the reliability of statistical tests.

Median The value found in the middle of an ordered distribution (i.e. half the values are above the median and half the values are below the median).

Pap smear or Papanicolaou screening test A microscopic examination of cells scraped from the cervix that can detect cancerous or precancerous conditions (see cytology), which would require histological confirmation of the presence or absence of disease.
normal smear A normal smear indicates that no abnormal cells are present on a smear sample.
abnormal smear An abnormal smear indicates cell changes that range from an inflammatory atypia to malignancy.

Primary cancer A malignant tumour confined to the organ of origin (also, see secondary cancer).

PYLL The number of potential years of life lost due to the premature mortality of an individual.

Screening Screening is a way to find out which people in the population are likely to have a disease or condition as compared with those who probably do not. There are many tests available to screen for conditions as part of preventive health measures such as Pap smear and mammogram.

Secondary cancer A malignant tumour that has spread (metastasized) to parts of the body remote from the primary site (also, see primary cancer).

Staging Classification of spread of disease, typically at time of diagnosis.

Standard population A reference population that is used to standardize measurements and indices. In the context of this report, the population age structure or distribution of the whole of Canada as it was in 1991 is used as this standard population. See also, age standardization.

Survival rate The proportion of people diagnosed with cancer who are still alive after a given period of time, most commonly one, five or ten years after diagnosis. Also referred to as the "crude survival rate".

APPENDIX A

Table A1. New cases of in situ cancer, by sex, Nova Scotia 2000-2004.

FEMALES	**New Cases**
ORAL (buccal cavity and pharynx)	11
DIGESTIVE ORGANS	
Colon and Rectum (colorectal)	83
RESPIRATORY SYSTEMS	
Larynx	5
Lung, Trachea and Bronchus	4
SKIN[1]	230
BREAST[2]	551
GENITAL ORGANS	
Cervix	2,018
Body of Uterus	0
Other Female Genital	152
URINARY ORGANS	
Bladder	116
Kidney,Ureter and Other Urinary	14
OTHER CANCERS	4
ALL CANCERS	3,188
MALES	
ORAL (buccal cavity and pharynx)	10
DIGESTIVE ORGANS	
Colon and Rectum (colorectal)	111
RESPIRATORY SYSTEMS	
Larynx	13
Lung, Trachea and Bronchus	5
SKIN[1]	223
GENITAL ORGANS	
Prostate	100
Penis and Male Genital Unspecified	20
URINARY ORGANS	
Bladder	317
Kidney,Ureter and Other Urinary	23
OTHER CANCERS	20
ALL CANCERS	842

[1] Excludes basal and squamous cell skin cancers.
[2] New cases of male breast cancers are included in 'Other Cancers'.

APPENDIX B

DATA SOURCES, QUALITY, CONFIDENTIALITY AND PROCESSING

Data Sources

All cases of cancer diagnosed in the province of Nova Scotia must be legally reported (Office of the Legislative Counsel 1989) to the Surveillance and Epidemiology Unit (SEU) of *Cancer Care Nova Scotia*, the group that manages the Cancer Registry. This information is obtained from the following sources:

Pathology reports
Provincial Pathology Laboratories

Registry report forms
Hospital Health Record Departments, Physician Offices or other Hospital Departments

Cancer Centre referrals
Electronic records of patients referred to provincial Cancer Centres

Death certificates
Nova Scotia Vital Statistics

Reciprocal notifications
Other Canadian Registries

Demographic information about the individuals and the nature of their cancer(s)[15] are recorded. All primary cancer types and death cases are coded in accordance with the International Classification of Diseases (Table B1).

Data quality

Data quality and accuracy is ensured through a network of activities including automated and manual edit processes, record linkages and data audits. SEU operations are in accordance with the cancer registration standards of both the Canadian Cancer Registry (CCR) and the North American Association of Central Cancer Registries (NAACCR). The SEU is also a member of the International Association of Cancer Registries (IACR), which fosters the international exchange of information between cancer registries.

Data quality indicators for common cancers diagnosed between 2000 and 2004, show that on average, nearly 90% of cancer cases have been confirmed through pathology and less than 1.5% are detected only at death (Table B2). The mortality to incidence ratios (deaths/cases) are similar to those reported in other Canadian provinces, and tend to be higher for lung cancer for which prognosis is poor.

Data confidentiality

The maintenance of data confidentiality is a guiding principle for all SEU operations. Strict guidelines govern data access and handling from the initial registration of a case through to research and reporting. Only qualified SEU staff, operating within security guidelines, have access to Cancer Registry records. To ensure the continued anonymity of the persons followed by the SEU, age-specific and site-specific cancer summaries are not presented when counts are below five cases. The Research Ethics Board of the Capital Health must approve all research studies undertaken by the SEU.

Data processing

Cancer incidence records were extracted from the Oncology Patient Information System (OPIS) database and studied by sex, age groups, tumour sites, geography and over time, with the most recent complete data being available for the calendar year 2004. Cancer mortality records were obtained from the provincial registrar of vital statistics. Population counts were obtained from Statistics Canada and derived from intercensal estimates for the period of 1971-2001 and from postcensal estimates for the period of 2002-2004.

Cancer incidence rates are presented at the county, DHA and provincial levels as well as over time (1971-2004). Mortality rates are presented at the provincial level and over time. Rates were age-standardized (see glossary) to allow meaningful comparisons of cancer rates over time and between geographic regions. The direct method was used in this report to compute age-standardized rates. The standard population used was that of the whole of Canada, as it was in 1991.

[15] *An individual may be diagnosed with more than one cancer in their lifetime.*

Table B1 Groupings of primary invasive cancers and their component International Classification of Diseases codes

CANCER TYPE	International Classification of Diseases			
	ICD-9[1]	ICD-O[2]	ICD-O2[3]	ICD-O3[4]
ORAL (buccal cavity and pharynx)				
Lip	140	140	C00	C00
Tongue	141	141	C01 C02	C01 C02
Mouth, Other	142 143 144 145	142 143 144 145	C03 C04 C05 C06 C07 C08	C03 C04 C05 C06 C07 C08
Pharynx and Tonsil	146 147 148 149	146 147 148 149	C09 C10 C11 C12 C13 C14	C09 C10 C11 C12 C13 C14
DIGESTIVE ORGANS				
Oesophagus	150	150	C15	C15
Stomach	151	151	C16	C16
Small Bowel	152	152	C17	C17
Colon and Rectum (colorectal)	153 154	153 154	C18 C19 C20 C21 C26	C18 C19 C20 C21 C26
Liver and Biliary Tract	155 156	155 156	C22 C23 C24	C22 C23 C24
Pancreas	157	157	C25	C25
Peritoneum and GI[5] Unspecified	158 159	158 159	C48	C48
RESPIRATORY SYSTEM				
Paranasal Sinuses	160	160	C30 C31	C30 C31
Larynx	161	161	C32	C32
Lung (Lung, Trachea and Bronchus)	162	162	C33 C34	C33 C34
Mediastinum, Pleura	163	163 164 165	C37 C38 C39	C37 C38 C39
BONE, CONNECTIVE TISSUE AND SKIN				
Bone and Connective Tissue	170 171	170 171	C40 C41 C47 C49	C40 C41 C47 C49
Melanoma of Skin	172	173	C44	C44
BREAST	174 175	174 175	C50	C50
GENITAL ORGANS				
Cervix	180	180	C53	C53
Body of Uterus	182	182	C54	C54
Ovary	183	183	C56	C56
Other Female Genital	181 184	179 181 184	C51 C52 C55 C57 C58	C51 C52 C55 C57 C58
Prostate	185	185	C61	C61
Testis	186	186	C62	C62
Penis and Male Genital Unspecified	187	187	C60 C63	C60 C63
URINARY ORGANS				
Bladder	188	188	C67	C67
Kidney, Ureter and Other Urinary	189	189	C64 C65 C66 C68	C64 C65 C66 C68
EYE AND LACRIMAL GLAND	190	190	C69	C69
BRAIN AND CENTRAL NERVOUS SYSTEM				
Brain	191	191	C71	C71
Meninges, Spinal Cord & other CNS		192	192	C70 C72 C70 C72
ENDOCRINE GLANDS				
Thyroid	193	193	C73	C73
Other Endocrine	194	194	C74 C75	C74 C75
LEUKEMIA	204 205 206	980 981 982 983 984 985 986	980 982 983 986 987	980 982 983 986 987
	207 208	988 989 991 992 993 994	989 991 993 994	989 991 993 994
OTHER BLOOD AND LYMPH TISSUE				
Non-Hodgkin's Lymphoma	200 202	959 960 961 962 963 964	959 967 968 969	959 967 968 969
		969 970 971 972	970 971 972	970 971 972
Hodgkin's Lymphoma	201	965 966	965 966	965 966
Multiple Myeloma	203	973	973	973
MISCELLANEOUS PROLIFERATIVE		975	974 976	974 976
OTHER AND ILL DEFINED SITES	195	195	C76	C76
UNKNOWN PRIMARY	196 197 198 199	199	C80	C80

1 ICD-9 refers to the Ninth Revision of the International Classification of Diseases.
2 ICD-O refers to the International Classification of Diseases for Oncology.
3 ICD-O2 refers to the Second Revision of the International Classification of Diseases for Oncology.
4 ICD-O3 refers to the Third Revision of the International Classification of Diseases for Oncology.
5 GI, gastrointestinal.

Table B2 Data quality indicators for common invasive cancers, Nova Scotia 2000-2004.

	Proportion of Cases Confirmed Microscopically (%)[1]					Proportion of Cases Confirmed with a Death Certificate Only (% DCO[2])					Mortality/Incidence Ratio (%)[3]				
CANCER TYPE	**2000**	**2001**	**2002**	**2003**	**2004**	**2000**	**2001**	**2002**	**2003**	**2004**	**2000**	**2001**	**2002**	**2003**	**2004**
MALES															
Colon and Rectum (colorectal)	92.3	90.0	95.7	92.6	93.4	1.3	2.0	0.7	0.5	1.0	39.9	37.8	41.0	42.0	44.7
Lung, Trachea and Bronchus	78.7	72.4	78.3	79.1	76.8	1.8	4.2	1.5	1.5	2.3	88.4	82.4	76.3	87.0	83.4
Prostate	95.5	96.7	97.8	97.4	97.8	1.7	1.1	0.6	0.3	0.5	21.2	17.3	20.5	15.5	16.9
ALL CANCERS	**89.1**	**87.8**	**89.6**	**90.2**	**89.2**	**1.6**	**2.1**	**0.9**	**0.7**	**1.2**	**47.5**	**45.0**	**47.7**	**47.0**	**46.6**
FEMALES															
Colon and Rectum (colorectal)	90.5	90.1	92.8	91.4	92.3	2.9	1.6	0.6	1.4	0.8	46.1	38.7	43.4	49.7	42.7
Lung, Trachea and Bronchus	75.4	77.2	81.1	77.7	79.9	3.1	2.2	1.0	2.1	3.3	69.8	75.3	84.0	83.5	80.8
Breast	97.0	97.5	98.4	97.4	97.8	1.7	0.6	0.4	1.0	1.1	27.8	25.9	23.7	35.3	24.1
ALL CANCERS	**88.3**	**88.4**	**89.9**	**88.7**	**89.3**	**2.3**	**1.6**	**0.7**	**1.6**	**1.9**	**46.1**	**44.1**	**46.3**	**50.8**	**46.9**
MALES AND FEMALES															
Colon and Rectum (colorectal)	91.5	90.1	94.4	92.1	92.9	2.0	1.8	0.6	0.9	0.9	42.8	38.2	42.1	45.5	43.8
Lung, Trachea and Bronchus	77.3	74.6	79.4	78.5	78.1	2.3	3.3	1.3	1.8	2.7	80.5	79.3	79.3	85.5	82.3
Breast	97.0	97.5	98.4	97.4	97.8	1.7	0.6	0.4	1.0	1.1	27.8	25.9	23.7	35.3	24.1
Prostate	95.5	96.7	97.8	97.4	97.8	1.7	1.1	0.6	0.3	0.5	21.2	17.3	20.5	15.5	16.9
ALL CANCERS	**88.8**	**88.1**	**89.7**	**89.5**	**89.3**	**1.9**	**1.8**	**0.8**	**1.1**	**1.6**	**46.8**	**44.6**	**47.0**	**48.8**	**46.8**

[1] A high proportion (%) of microscopic confirmation indicates that figures are not overestimates of cancer incidence.
[2] The proportion of DCO cases is recommended to be < 5% by the Canadian Cancer Registry. A high % of DCO cases may indicate inadequate cancer registration processes.
[3] The mortality: incidence ratio is expected to be <100% and tends to be higher for cancer sites with poor survival.

The majority of detailed analysis was conducted after pooling data over a five-year time period (2000-2004)[xxiii] to reduce problems associated with the computations based on small numbers. This approach was essential to provide a reliable and stable profile of cancer incidence, mortality and survival in the province. Variance estimates (and 95% confidence intervals) were calculated assuming the age-specific counts were random Poisson events (e.g., in the calculation of age-standardized incidence and mortality rates-ASIR and ASMR, respectively).

The number of potential years of life lost (PYLL) was calculated by obtaining the number of deaths for ages, 0-4, 5-9, 10-14, ... 90+ recorded for Nova Scotia in 2004 and the life expectancy at the midpoints of the age groups as listed in the Nova Scotia 2000-2002 life tables. The PYLL is obtained by multiplying, for each age group, the number of deaths by the average life expectancy of people that age. This data is available on *Cancer Care Nova Scotia*'s website *www.cancercare.ns.ca*.

Comparative incidence figures (CIF) were derived from the ratio of the average annual (2000-2004) ASIR for a given cancer type recorded in a specific geographical area (i.e., a county or a DHA) to the average annual ASIR for that same cancer type for the whole of Nova Scotia. The computation of the 95% confidence intervals followed the methodology described by Breslow and Day.[xxiv]

An average annual percent change (AAPC) was calculated for the period 1996-2004 by fitting a linear regression model to logarithmically transformed ASIR and ASMR, a procedure that assumes a constant rate of change in both ASIR and ASMR, over the time studied. The slope resulting from the fit was back-transformed and expressed as a percent increase or decrease in the rate of cancer incidence or mortality over the indexed period.

Cancer prevalence was determined using the counting method[xxv] applied to the incidence and mortality data for the period of 1996-2004.

[xxiii] *Time trends in cancer incidence and mortality elapsed over a larger time period 1971-2004; average annual percent change in cancer incidence and mortality focused on the period 1996-2004; relative survival estimates focused on the period 1997-2001; projection estimates were derived from various time periods determined by selecting significant changepoints in trends detected with Joinpoint, see Table B3 for details.*

This method counted the number of people alive on a particular date (index date), who were previously diagnosed with cancer within a given time period (i.e. within 15 years from the index date). This method, known as limited-duration prevalence can estimate prevalence for a small or large number of years following the diagnosis regardless of the patient clinical status (i.e. cured or still under treatment).[7] In this report, limited-duration prevalence was calculated at 15 years post-diagnosis, for which the counting of cases began in 1990. Prevalence can refer to the number of people with cancer or the number of cancers in a population.[7] Person-based prevalence considers only the first primary cancer diagnosed in each person, and so reflects the number of people making demands on health care resources. Tumour-based prevalence considers all primary cancers in a person, which if treated independently, may be more pertinent to the demand on health care. Both person-based and tumour-based prevalence were reported in this publication for common cancers and all cancers combined. A person diagnosed with an invasive primary breast cancer in both 2000 and 2001, and a

Table B3. Time frames selected for the projections of incidence and mortality cases.

CANCER TYPE		MALES		FEMALES	
	Age Group	Incidence	Mortality	Incidence	Mortality
ORAL (buccal cavity and pharynx)	All				
DIGESTIVE ORGANS					
Oesophagus	All				
Stomach	All				
Colon and Rectum (Colorectal)	All				
Pancreas	All				
RESPIRATORY SYSTEM					
Larynx	All				
Lung, Trachea and Bronchus	< 55				
	55 - 69	1993 - 2004	1992 - 2004	1993 - 2004	1991 - 2004
	70+	1998 - 2004	1994 - 2004	1999 - 2004	1999 - 2004
SKIN					
Melanoma of Skin	All				
FEMALE BREAST	< 55			1997 - 2004	
	55 - 69			1998 - 2004	
	70+				
GENITAL ORGANS					
Cervix	All				
Body of Uterus	All				
Ovary	All			1999 - 2004	
Prostate	All	1994 - 2004	1995 - 2004		
URINARY ORGANS					
Bladder	All	2000 - 2004		2000 - 2004	
Kidney	All				
BRAIN	All				
ENDOCRINE GLANDS					
Thyroid	All				
LEUKEMIAS	All				
OTHER BLOOD AND LYMPH TISSUE					
Non-Hodgkin's Lymphoma	All				
Hodgkin's Lymphoma	All				
OTHER CANCERS	< 55				
	55 - 69				
	70+	1993 - 2004			

Unless otherwise noted, data for the period 1990 - 2001 was used for projection.

primary invasive lung cancer in 2002 would be counted in their respective 5 years site-specific prevalence as following: tumour-based 5 years prevalence: breast= 2 counts; lung = 1 count and all cancers = 3 counts; person-based 5 years prevalence: breast = 1 count; lung = 1 count, all cancers = 1 count.

Estimates of new cases, or age-standardized incidence rates to be observed in the future result from a multi-step process. First, an analysis of time trends was performed on each cancer site using the JoinPoint program provided by the National Institutes of Health.[xv] This method searches the trend data for time points at which there is sufficient evidence that the trend has changed. Only the data that adheres to that most recent trend is used in the projection of future rates (see Table B3).

The second step is that of fitting regression models to the data from the selected time periods and projecting them to the years 2010, 2015 and 2020. For the projection of age-standardized rates, the process stops there. The model used for this process is a simple weighted linear regression of the age-standardized rates, with the weights being the inverse of the variance of the rates.

For the projection of expected cases, the last step is to apply the projected age-specific rates to the population projections provided by Statistics Canada for the future years.[xvi] The population projection chosen is characterized by medium growth, with migration patterns similar to today's patterns. Thus, the projection process takes into account expected changes in the size and age structure of the future population, as well as changes in underlying risk of disease as described by recent age-specific trends. The regression models used were linear in the rate, in the presence of increasing trends, and a poisson model (linear in the log of the rate) for decreasing trends. Inverse variance-weighted regression was also used for all these models. If no trend was detected (test for trend > .1), a constant rate, based on the most recent 5 years' data was used. A parallel analysis was used for mortality rates and counts.

Relative survival analyses were conducted by cancer type and extent of disease (a measure of how far a cancer has spread in the body at the time of diagnosis), a factor that is strongly associated with the survival of cancer patients. Analyses were based on the cohort method[xvii] for patients diagnosed with invasive primary cancer between 1997 and 2001, and followed to the end of 2004. Because 2004 was the most recent complete year of mortality data, only those patients diagnosed prior to 2001 contributed to the five-year relative survival estimates, however, patients diagnosed in 2001 contribute to estimates up to the fourth year of survival. Analyses focused upon the four major cancer types: colorectal, lung, breast and prostate.

If a patient was diagnosed with more than one invasive tumour between 1997 and 2001, only the record with the earliest date of diagnosis was retained for analysis.[xviii] Patients with a previous record of malignancy (at any point from 1971 to 1997) were also excluded from the analysis. Finally, reliable dates of diagnosis were unavailable for individuals diagnosed through autopsy or death certificate only (DCO). The exclusion of these cases, while necessary, slightly biases the survival ratios presented in this report (e.g., Berrino et al. 1995).[xix]

In contrast to cohort estimates of relative survival, period estimates (which consider only the survival experience of patients in the year 2004, the period of interest), are considered to be more 'up to date', and more likely than cohort estimates to reflect the actual survival experience of recently-diagnosed patients. This is because the information about the short-term survival of patients diagnosed in earlier time periods is ignored. Patients from earlier time periods only contribute information on long-term survival, while patients diagnosed more recently contribute information on short-term survival.[xx][xxi]

Relative survival estimates compare the observed survival for a group of cancer patients to the survival that would be expected for members of the general population who have the same characteristics - sex, age group, and province of

residence – as the cancer patients.[1] Observed survival time was calculated as the difference in days between the date of diagnosis and the date of last observation (date of death or December 31, 2004, whichever was earliest) to a maximum of five years. Expected survival time was derived for each age, up to 99 years of age, from sex-specific provincial life tables provided by Statistics Canada. Thus, if the five-year survivorship was 65% for a group of cancer patients that would otherwise have expected a 90% survivorship, the relative survival rate would be 72% (65/90).[1] That is, relative survival ratios are greater than the observed (crude) rates, which do not account for increases in general mortality with age. By convention, relative survival is called a "rate", although it is actually a ratio of two proportions, expressed as a percentage.

The relative survival estimates presented in this report account for age-specific differences in background mortality, but not for the influence of age on the prognosis of a cancer patient. That is, the rates presented were not age-standardized to a "cancer patient population standard" such as that of the World Standard Cancer Population or the EUROCARE standard.[2] This allowed the computation of relative survival estimates that more closely reflect the reality of cancer patient survival and treatment outcomes in Nova Scotia, but means that comparisons between these survival estimates and estimates from other jurisdictions may be influenced by differences in the age distributions of the respective cancer patients.

Finally, confidence intervals (CI) of observed survival were derived from an approximation of the formula of Greenwood (1926; as per Armitage and Berry 1985[3]) to provide an indication of the precision associated with the calculated rates. This method accounts for the gradual reduction in sample size due to patient death. Confidence intervals for the relative survival proportions were derived by dividing the observed survival limits by the expected survival proportion.[1]

APPENDIX C

Table C1. Deaths due to cancer, Nova Scotia 2000-2004

CANCER TYPE	Number of Deaths		
	TOTAL	MALES	FEMALES
Lung, Trachea and Bronchus	3,210	1,914	1,296
Colon and Rectum (Colorectal)	1,633	842	791
Breast	898	9	889
Prostate	629	629	n/a[1]
Pancreas	600	296	304
Non-Hodgkin's Lymphoma	407	224	183
Leukemia	358	204	154
Stomach	323	191	132
Kidney, Ureter and Other Urinary	286	181	105
Brain	269	148	121
Ovary	268	n/a[1]	268
Bladder	264	195	69
Oesophagus	260	207	53
Liver and Biliary Tract	241	126	115
Multiple Myeloma	209	106	103
Melanoma of Skin	134	74	60
Body of Uterus	119	n/a[1]	119
Pharynx and Tonsil	105	83	22
Cervix	105	n/a[1]	105
ALL CANCERS	**11,729**	**6,201**	**5,528**

[1] n/a, not applicable

Appendix C *(cont'd.)*

Table C2. Actual and projected annual incidence (new cases) of invasive cancer, Nova Scotia[1]

CANCER TYPE	ACTUAL			PROJECTED[2]								
	2004			2010			2015			2020		
	males	females	total	males	females	total	males	females	total	males	females	total
ORAL (buccal cavity and pharynx)	86	43	129	80	40	120	80	40	120	80	40	120
DIGESTIVE ORGANS												
Oesophagus	40	13	53	50	10	60	60	10	70	70	10	80
Stomach	65	38	103	60	30	90	60	30	90	60	30	90
Colon and Rectum (Colorectal)	409	363	772	510	420	930	600	470	1,070	720	540	1,260
Pancreas	61	72	133	60	60	120	70	60	130	80	70	150
RESPIRATORY SYSTEM												
Larynx	35	<5	40[3]	30	10	40	30	10	40	30	10	40
Lung, Trachea and Bronchus	470	333	803	470	350	820	490	380	870	520	400	920
SKIN												
Melanoma of Skin	105	99	204	120	110	230	150	130	280	180	160	340
FEMALE BREAST[3]		647	647		680	680		700	700		730	730
GENITAL ORGANS												
Cervix		62	62		50	50		50	50		50	50
Body of Uterus		120	120		130	130		140	140		150	150
Ovary		56	56		60	60		50	50		50	50
Prostate	733		733	800		800	890		890	1,000		1,000
URINARY ORGANS												
Bladder	101	36	137	90	40	130	90	40	130	110	40	150
Kidney	105	69	174	120	80	200	140	100	240	160	120	280
BRAIN	39	36	75	50	30	80	50	30	80	60	30	90
ENDOCRINE GLANDS												
Thyroid	17	51	68	20	60	80	20	70	90	30	80	110
LEUKEMIAS	68	47	115	60	50	110	70	50	120	70	60	130
OTHER BLOOD AND LYMPH TISSUE												
Non-Hodgkin's Lymphoma	119	86	205	120	100	220	140	110	250	150	120	270
Hodgkin's Lymphoma	18	15	33	20	10	30	20	10	30	20	10	30
OTHER CANCERS	271	216	487	300	250	550	330	280	610	380	320	700
ALL CANCERS[4]	**2,740**	**2,400**	**5,140**	**2,960**	**2,560**	**5,520**	**3,270**	**2,750**	**6,020**	**3,690**	**3,020**	**6,710**

[1] Time periods selected for the projected counts appear in Table B3.
[2] New cases of male breast cancers are included in 'Other Cancers'.
[3] Counts have been rounded.

Table C3 Actual and projected annual deaths due to invasive cancer, Nova Scotia

CANCER TYPE	ACTUAL			PROJECTED[1]								
	2004			2010			2015			2020		
	males	females	total	males	females	total	males	females	total	males	females	total
ORAL (buccal cavity and pharynx)	22	13	35	30	10	40	30	10	40	30	10	40
DIGESTIVE ORGANS												
Oesophagus	48	10	58	50	10	60	60	10	70	70	10	80
Stomach	36	31	67	30	20	50	30	20	50	30	20	50
Colon and Rectum	183	155	338	190	170	360	220	180	400	260	210	470
Pancreas	65	75	140	70	60	130	70	70	140	80	80	160
RESPIRATORY SYSTEM												
Larynx												
Lung, Trachea and Bronchus	392	269	661	390	280	670	410	300	710	440	330	770
SKIN												
Melanoma of Skin	17	17	34	20	10	30	20	10	30	30	20	50
FEMALE BREAST[2]		156	156		180	180		200	200		220	220
GENITAL ORGANS												
Cervix		23	23		20	20		20	20		20	20
Body of Uterus		28	28		20	20		30	30		30	30
Ovary		61	61		60	60		60	60		70	70
Prostate	124		124	100		100	90		90	90		90
Testis												
URINARY ORGANS												
Bladder	39	15	54	40	20	60	50	20	70	60	20	80
Kidney	39	14	53	40	20	60	50	20	70	60	30	90
BRAIN	31	25	56	30	30	60	40	30	70	40	30	70
ENDOCRINE GLANDS												
Thyroid												
LEUKEMIAS	43	39	82	40	30	70	40	30	70	50	30	80
OTHER BLOOD AND LYMPH TISSUE												
Non-Hodgkin's Lymphoma	58	46	104	60	50	110	70	60	130	80	70	150
Hodgkin's Lymphoma												
OTHER CANCERS	169	151	320	220	180	400	260	210	470	310	240	550
ALL CANCERS[3]	**1,280**	**1,130**	**2,410**	**1,320**	**1,170**	**2,490**	**1,440**	**1,260**	**2,700**	**1,640**	**1,420**	**3,060**

[1] Time periods selected for the projected counts appear in Table A1.
[2] New cases of male breast cancers are included in 'Other Cancers'.
[3] Death counts have been rounded.

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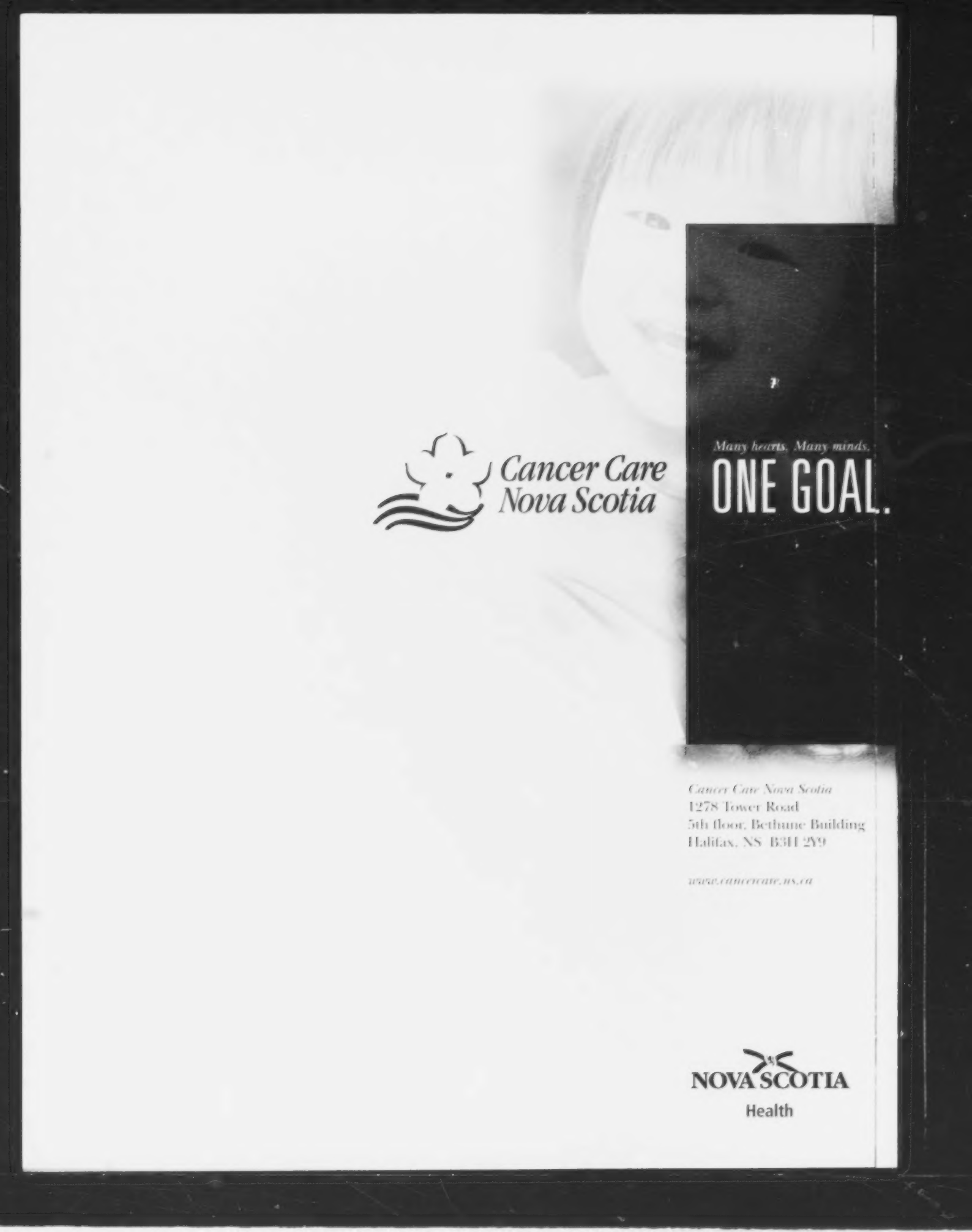

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